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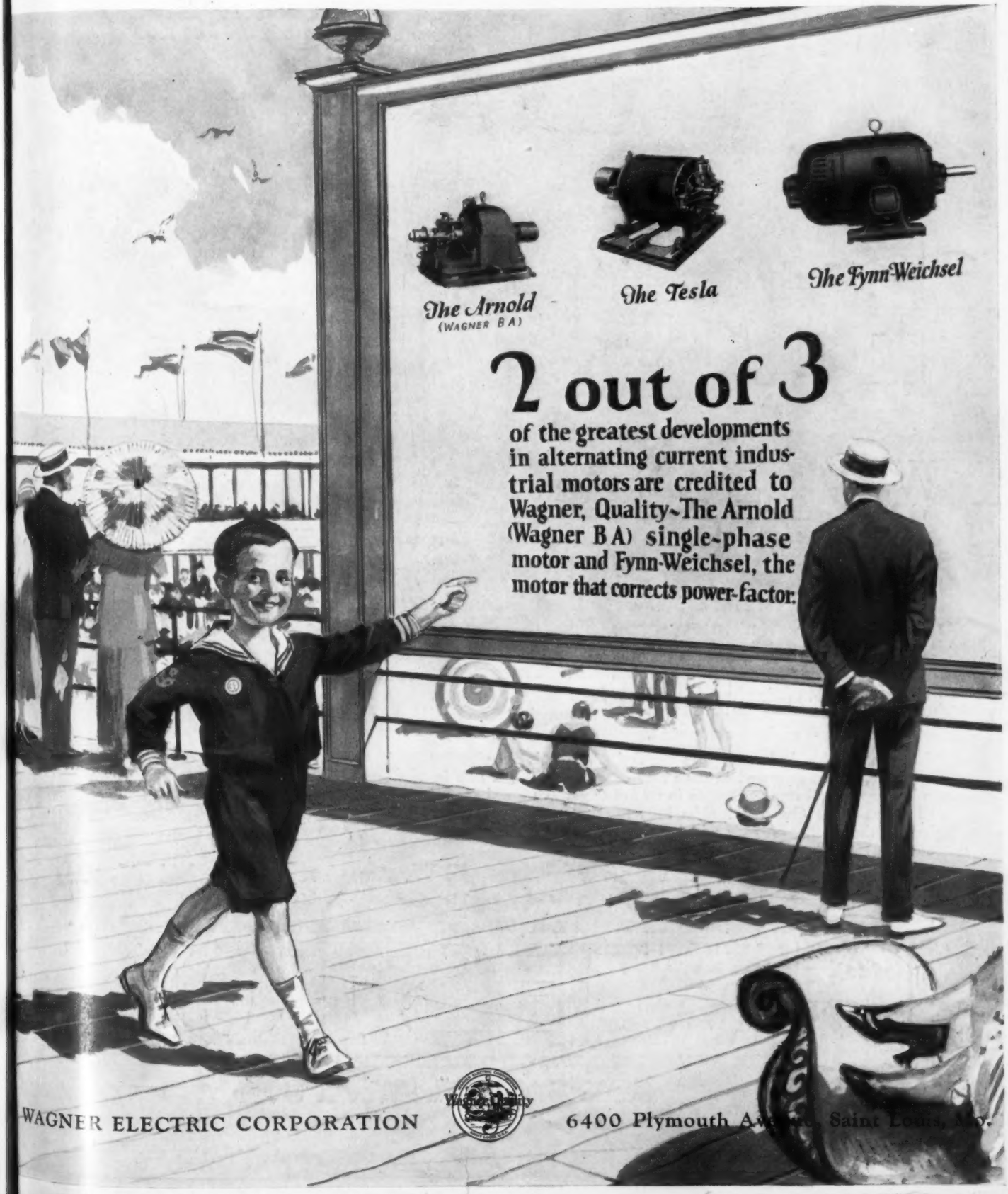
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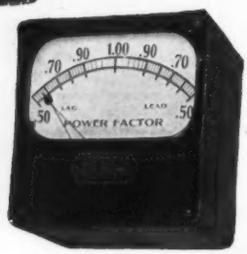

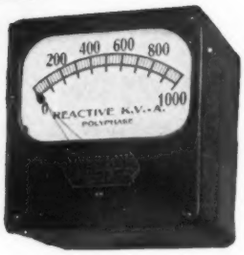

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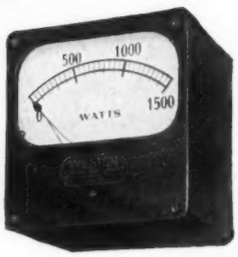

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W. H. ONKEN, JR. Editor — HAROLD V. BOZELL Editor

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Individual Initiative and Co-operative Counsel

THE electric light and power industry of the United States is one of the greatest and most striking examples of the results of the traditional American policy of individual initiative, individual responsibility and individual action. Pioneering and enterprise in engineering coupled with boldness of execution and business acumen have made possible an electrical service to the public and to industry unequaled in any other part of the world. And demands of future growth and problems of future development of this industry will continue to present unlimited opportunity for individual initiative and action, whether it be along the lines of engineering, of finance or of business.

But while the industry in its present form would have been impossible without individual initiative, sight must not be lost of the part played by such organizations as the National Electric Light Association. Organized as a result of early appreciation of the value of intimate exchange of opinion and of joint study of common problems, it has long been a vital influence in helping those who carry responsibility to make their plans and decisions in the light of the best practice and to gain the advantage of standardized methods and equipment.

Useful and constructive as the N. E. L. A. has been in the past, it has even greater opportunity for usefulness in the future. The central-station industry will grow in the next decade as much as it has in the more than forty years of its history. Superpower and interconnection, while old in practice and older in theory, have taken on new significance and present new questions. Greater concentration of power and more extensive interconnection mean engineering as well as executive problems and decisions of increased complexity and magnitude. With its increasing service to the public, the electrical industry has itself become an object of greater interest to the public and their mutual relations assume new prominence. The problems of such an expanding business demand keener commercial sense and development of adequate commercial practices and policies. Larger capital accumulations and more widespread ownership of securities by customers mean greater effort in building and managing capital structures. And so there is unlimited opportunity for service by the organization.

That the N. E. L. A. will assume the responsibility which goes with increased opportunity is already evident. As the problems of the electrical industry become more numerous, more complex, more important, the N. E. L. A. committees and the rest of its organization are being adjusted so that first consideration is given to those subjects of most importance and so that the results of the association's studies commend themselves as comprehensive and authoritative. The outcome of the past year's work, coupled with the program of the convention to be held in Atlantic City in the week of May 19, gives conclusive evidence of the continued value of this agency for co-operative counsel. It serves constantly to forward opportunities for individual initiative and to encourage and inspire both individual and collective development in the electrical industry.

What the Range Survey Means— What It Should Lead To

IN STARTING its survey of a typical electric range load in Spokane, Wash., the N. E. L. A. range committee is performing a service for the industry for which there has been a long-felt want. Central-station executives, commercial men and engineers have all needed more definite data concerning the characteristics of this load so that they could make intelligent plans for selling and serving the electric range at a profit. The results of the range committee's investigation will go far in throwing light on questions regarding diversity and demand factors, investment, service costs and so forth, about which there is a wide difference of opinion.

But, however well the range committee may do its work, the collection of this information should not be confined to the survey in the Northwest. The committee is doing all it possibly can in offering four alternative methods of conducting a survey and in carrying out its work in Spokane, but central-station companies throughout the country which have electric ranges on their lines should make individual investigations to determine what conditions exist in their own territory. Some one of the four methods proposed could be adapted to almost any local situation. If the central-station companies will do this and publish the resultant data for comparative purposes, the true value of the electric range load will soon be determined, and if there are any difficulties to be overcome, their exact nature and degree will at least be known and can be provided for.

Three Essentials in Small-Town Merchandising

HOW much or how little is accomplished in merchandising in small towns depends upon the degree to which the utility company achieves three essentials—(1) a good manager, (2) a good store in a good location, and (3) good merchandising practices. Of the three the most essential is the good manager. He is the utility in the mind of the public, and he must be of a caliber that enables him to bring about good public relations and adequate revenues while acting as an engineer, financier, salesman, business man and executive. A small-town manager has a white-collar job that requires the type of man in miniature that fills the president's chair in a large utility organization. He is difficult to find or to keep and deserves good compensation.

The second essential is a good store in a good location. The numerous chain stores have found it "good business" to study traffic conditions in order to locate their branches in cities, and the utility merchandise store should have the best location in town. This brings business through window displays and, still better, it determines the style for the other stores. Examples can be cited where a utility store with proper window displays, showcases, tables and good lighting sounded the death knell to out-of-date windows and lighting installations in all the other stores. A good store becomes a matter of civic pride and the guide to better things, and it is highly advantageous for the utility to lead in this work.

And yet merchandising is a business that requires business principles for its success. Low costs, adequate records, advertising, attractive displays, prompt deliveries and provision for servicing are all essential, and practices that have been found good in any retail business can and should be applied to the appliance merchandise business. Assuming it to exemplify the three essentials named, merchandising can and should stand on its feet as a profitable enterprise with a gross return equal to or greater than that obtained from the sale of energy to lighting customers. Moreover, and not least important, this kind of business is a very great aid in building up revenues from energy sales and helps to popularize the company and its service.

Service Reliability of Long Spans

HIGH-TENSION transmission lines using four or five towers per mile have been constructed recently in several parts of the country. On a first-cost basis, in both hilly and level territories, these installations show appreciable savings when compared with the usual shorter-span insulations. But time is needed to answer some questions raised as to the comparative service reliability of these long spans. For example, the steel-cored conductors are pulled to a tension of about 8,000 pounds, and with wind and ice loadings there is some question of conductor strength, the elastic limit being only about 11,000 pounds. The towers themselves also must undergo very great stresses at times, and the new designs have yet to be proved in service. Another question is the effect of vibration on the strength of the conductors; vibration is naturally great, and it theoretically may result in metal fatigue. But from this angle the new practice stands on firmer ground, for tests of long steel conductors on special long spans, such as exist at Carquinez Straits, have shown no evidences of crystallization after several years of service. Another danger is that in stringing these long spans the conductors may be nicked by rocks or other obstacles and thus weakened or even have strands broken which will untwist and give trouble. There exists, too, the difficulty in taking up slack if conductors break so that repairs can be made readily.

Service experience will soon give definite answers to these questions, and it is to be hoped that they will all prove to be favorable, for reduction in transmission installation costs will make for a more rapid extension of high-tension networks.

Preheated Air Proving Popular in Central Stations

THE advent of air heaters in this country is very recent and was stimulated by the studies made on the efficiencies obtained from high-pressure feed-water heating by bled steam. Owing to the feed water reaching a high temperature before it enters a boiler, some of the boiler heating surface becomes in a way superfluous, and the use of the combustion gases for heating the air entering the furnace enables the flue gases to be exhausted at a sufficiently low temperature.

But the studies also showed that air heating might be used profitably with existing boiler installations, and recent tests have resulted in conclusive data on the advantages to be obtained. Notable among the tests were those made at the Colfax station of the Duquesne Light Company, which in addition to securing a high

boiler efficiency over a wide range of rating showed that air preheaters are simple, low in first cost, operating cost and maintenance cost. Tests in other localities show the same results, and as a consequence air heaters are being installed or considered for use in many other existing stations. As a rule they can be installed without any major modification in boiler-house arrangements and without calling for additions to the building.

The more general application of air heaters, however, waits upon conclusive data over a long period as to the effect of the high temperatures on furnace refractories. This one element of doubt reacts particularly on stoker and chain-grate installations as it is possible to use highly preheated air with liquid or powdered fuels in a way to decrease the duty the refractories must undergo.

However, experience thus far indicates that the effect upon refractories has not been very important, and no great trouble is to be expected from this cause. The air heater has proved itself a real and economical asset for station designers to consider in connection with more efficient steam production.

New Permanent-Magnet Oscillograph
May Presage a Switchboard Type of Instrument

LAST year an announcement was made in England of the development of a new alloy steel out of which permanent magnets of remarkable strength and of only a fraction of the former weight have been made. A number of samples of such magnets were sent to interested persons in this country. So the profession naturally expected to see some noteworthy improvements in electrical devices in which permanent magnets play an essential part. Guesses differed as to which instrument would be the first one to be improved, and now an announcement comes of a "super-permanent-magnet" oscillograph, developed by one of the large manufacturing companies in this country. The weight of the permanent magnets is asserted to be less than one-twentieth the weight of former electromagnets, without any sacrifice in vibrator sensitivity. This has placed oscillographs on an entirely new basis and has also made possible a six-element oscillograph for three-phase short-circuit tests. This complete six-element oscillograph is even smaller than the standard three-element portable unit and requires only a 6-volt battery for lamps and motors. A single-element visual unit or "oscilloscope" has been compacted in a space of less than one-quarter of a cubic foot. The lamp for this unit operates on three dry cells and the permanent magnet galvanometer is less than one and one-half by three inches over all.

This new development will be welcome not only to those who use the oscillograph in test and research but also to many operating engineers who desire to know the wave form of the current and voltage on their lines. It brings nearer reality the dream of an "indicating oscillograph," to be placed on the switchboard and watched like the rest of the instruments. When this devoutly wished consummation shall be reached, the attendant, any time he does not like the looks of a current or voltage wave form, will simply push a button and, lo! an instantaneous photograph of the curve and of a clock will be obtained, to be discussed later with the "boss."

The Last Paper of
Dr. Ernest Fox Nichols

A TRAGEDY of great impressiveness occurred at the new and handsome hall of the National Academy of Sciences in Washington on the morning of April 29. It was the first session of the academy in the new building, following the dedicatory exercises of the preceding day. Several interesting papers were read according to schedule, and about 11 a.m. Dr. E. F. Nichols, the widely known physicist, went on the platform to read a paper on "Joining the Infra-Red and Electric Wave Spectra." He had been for a long time in poor health, but did not show any signs of weakness as he went up to speak to the academicians in their fine central auditorium. With clear voice and fine delivery he presented his subject, which was of great interest to all electrical men. His paper was illustrated by slides, and he spoke freely without notes.

His first slide showed a long vertically drawn column spectrum of electromagnetic waves. On the top of the column were the shortest known X-ray waves, of length 2 tenth-centimeters (2×10^{-10} cm.). At the bottom of the column was the approximately longest radio wave of 3 centimeter-sixes (3×10^{6} cm.), or 30 km., corresponding to a frequency of 10 kilocycles per second. This range of 1.5×10^{16} in ratio, or some 54 octaves, showed only about one octave of visible spectrum, near the fourth-centimeter point (1 micron). He showed that in all this long pathway of 54 octaves there had been left one gap of unexplored frequencies, having wave lengths a few centimeters long, where the infra-red joined on to the Hertzian short electromagnetic waves. He described how his work, still in progress, with a collaborator, J. D. Tear, closed that gap and made the whole series a continuously explored spectrum.

Very clearly and beautifully he described the stereopticon pictures, showing the methods and apparatus he used, with little Hertzian cylinders and with radiometers, to produce, detect and measure these little electromagnetic waves. He showed a most interesting picture of an echelon grating, composed of successive brass slabs, forming a doll's stairway, backed by an inclined glass sheet. He remarked as he pointed these out on the screen, "I think this will interest our president, Dr. Michelson," who sat on the platform opposite to him. He turned to the next slide, which showed two curves, one according to theory and the other to observation, concerning the behavior of this echelon. Without change in voice or bearing and without premonitory symptom, he said as the slide changed, "I think I must lie down," and sat on the rear bench of the platform, laying down his head on it, with the pointer still in his hand. So quietly was this said that even the president, on the platform near him, supposed that he had merely bent over for a few moments. For fifteen seconds the hall was perfectly still. Then the president went over and touched him gently. A call was given for a physician. When the physician went up Dr. Nichols was pulseless and showed no signs of life. The session immediately adjourned.

There was something very fine in this tragic close of an active career. A great scientist went to his rest, without suffering and suddenly, while narrating his victory over the unknown to his fellow academicians, with his wife and friends by his side. The triumph exceeded the calamity of his death. He closed the gap as he departed.

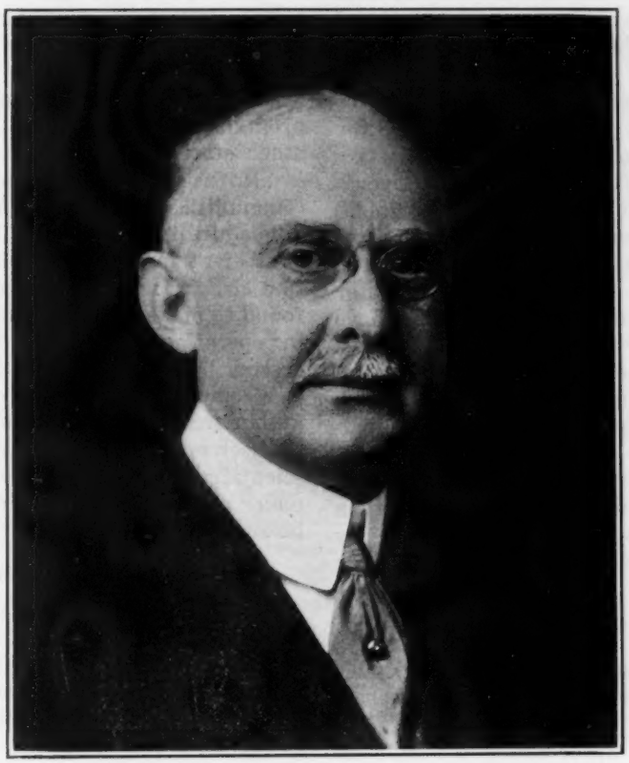
Airplane View of the Business Section of Philadelphia

Achievements of Electric Utilities

By Walter H. Johnson
President National Electric Light Association

Continued Growth and Expansion of the Industry Marked by Greater Efficiency and Economy—Activities Making for Good Will and Financial Strength

CONSIDERING it from any point of view, the continued growth and expansion of the electric light and power industry is nothing short of marvelous. The year has witnessed achievement upon achievement. The largest steam turbines, the mightiest water turbines and the highest-voltage transmission lines in the world have been placed in operation by electric public utility companies within the twelve months. Not to be outdone by the engineering department, the commercial heads of electric public utilities have acquired new business at such a rapid rate as to tax the generating and distributing facilities of the operating companies.



Walter H. Johnson

The organization which has been most instrumental in urging the industry onward, in visualizing the problems confronting it and in suggesting ways and means for coping with them is, of course, the National Electric Light Association. That organization has certainly made a remarkable showing during the past few years and has more than come up to expectations.

Organized to foster and promote the effectiveness of the service furnished by privately owned electric light and power companies engaged in the production, transmission and distribution of electricity, its sphere of influence and its activities have broadened with the years. In it are crystallized the national thought and ideals of the industry. Through the effective co-operation of member companies and by the interchange of experience and counsel, the highest economies and efficiencies are reached.

The controlling principles which bind thousands of operating companies together are simple and effective. They are that centralization of effort and production and the greatest possible volume of output are essential for the greatest economy and efficiency and to provide the maximum expansion, the highest standards of service and the lowest rates to the public. Only those who have delved deeply into the matter have any comprehension of the complexity and immensity of the task which confronts the electric light and power industry. Questions of engineering, however intricate, do not give us most concern. The industry possesses the necessary skill and experience to grapple with these problems. It has been along engineering lines that the greatest progress has been made so far. The broad subject of public relations is not so easily mastered, nor are the very important and pressing problems of finance.

That we know how to approach them, however, and are ingenious enough to adapt ourselves to conditions and circumstances is evidenced by the customer-ownership campaign which the industry originated. The sale of preferred or common stock to employees, customers and residents of communities served by the utility has not only been effective in raising large sums of new money from a source hitherto untouched, but it has also served to improve public relations and has increased the loyalty and efficiency of the workers themselves. But the trail has only been partly blazed.

However much companies may recognize the advantages of such popular ownership of their securities, the actual number of companies engaged in the work is still comparatively small. In some instances present stockholders will not relinquish rights, while in certain states the laws are such that customer ownership is unfeasible. For some time to come, however, it will be advantageous for electric public utilities to dispose of more and more junior securities, thereby increasing the equity back of the funded debt and making the sale of bonds and senior securities much easier and the rates more attractive. Already the investing public looks very favorably on electric public utility security issues, and we have every reason to believe that we

shall be able to cope with our financial problems as readily and as successfully as we have coped with engineering problems.

Superpower Stations and Systems

Within the industry the tendency toward superpower stations and the interconnection of systems is becoming more pronounced. These movements are economically sound and have not only resulted in a greater use of capital already invested, but have also improved service and made it possible at times to decrease its cost. The public has a somewhat distorted impression of superpower, just as it has an erroneous impression of the cheapness of water power. Little by little, however, these errors are being corrected, and it is along this particular line of public information that the National Electric Light Association has done some of its most effective work.

The federal water-power act of 1920 was a piece of broad constructive legislation. While it safeguarded the interests of the public and offered priorities to state and municipal governments, it was not unattractive to privately owned electric public utilities, and its stipulations were not such as to discourage the investment of capital in hydro-electric enterprises. As a result there has been renewed interest in the development of water power and electric light and power companies have been foremost in applying for permits from the Federal Power Commission. Since the organization of the commission approximately 450 applications have been filed, involving 35,000,000 hp. About one-third of the applications, involving 12,000,000 hp., have been rejected, canceled or withdrawn. Nevertheless, there is more hydro-electric development now actually under way than at any other time in the history of the industry. By the interconnection of hydro-electric stations with steam stations the water power is not only used most efficiently, but also to a greater degree than would otherwise be possible.

The electric light and power industry is thus able to use the numerous water powers more advantageously than any other industry, particularly in projected superpower systems where water-power development forms an important link in the system for carrying base loads or daily or seasonal peak loads. We have reached such a high degree of efficiency in the utilization of water in our modern hydro-electric stations that there has been very little room left for further improvement. Surveys, however, indicate that 55,000,000 hp. is available for development as soon as a market for the power is produced. While its non-use might at first blush appear as a reflection on the industry, most of it is in locations without any immediate available market and where development by any one would constitute economic folly. Of all the water powers harnessed in this country, fully 80 per cent have been developed by public utility companies.

Examples of Efficiency

The same improvement in efficiency which has marked hydro-electric development is also to be found in modern steam-station practice. Just as the new 70,000-hp. hydro-electric units at Niagara Falls, N. Y., produce twice as much energy from the same amount of water as the older units, so does the modern superpower station produce twice as much energy per pound of coal burned as the stations of a decade ago. Contrary to the popular impression, the electric light and power industry, despite its great output, uses only a small portion of the coal mined. Therefore, while we cannot aspire to the position of the packers, who recover everything except the squeal of the pig, we do claim to be wonderfully efficient as operators of electric light and power plants, regardless of the type of prime mover that is employed.

A remarkable feature of the electric light and power business, particularly along the Atlantic Coast and in the North Central States, is the large number of old houses that are being wired. This, coupled with great activity in the building line, has enabled public utility companies in many instances to install more new residence meters in one year than the company had customers a few years ago.

The electrification of American farms is desired by all electrical men, not only as a matter of national development, but also from a purely selfish standpoint. Electricity has been employed advantageously and profitably for many years on farms in California and other states where irrigation loads are available. It is also used rather extensively on farms adjacent to communities and cities possessing an enterprising public utility company. There are, however, a large number of farms within proximity of electric distribution circuits which may use electricity if a way can be found to make the extensions profitable. There are now in operation a number of experimental rural lines erected by public utilities under the advice of co-operative committees composed of farmers, state educational authorities, the rural press and the power companies themselves. By this means it is hoped to determine scientifically whether or not with certain rates and under certain conditions of load such rural lines would be an asset or a liability.

Public Relations

Few phases of public utility operation require as much consideration and care as the question of public relations. It is very generally recognized that the intangible thing known as good will is a tremendous asset to any electric public utility company. There is no doubt that the wonderful showing made by the electric public utilities of the country is in some degree due to the consideration given to patrons and the time spent in rectifying causes of complaint and in cultivating satisfactory relations with the public. Obviously, there can be no permanent good will that is not built upon efficient service at reasonable rates. The industry is alive to that as well as to the desirability of winning public respect and approval. Where there is mutual understanding and regard between the public and the utilities, experience has shown that both gain. Contracts for service are more easily closed; the sales of securities in the community are greatly facilitated; general operating conditions are improved, and the cost of capital is a point or two less. In business there is nothing comparable to a good reputation. Animated as the electric public utilities are with a sincere desire to serve, high public regard must follow, if the management of the utility pursues an enlightened public policy. The stability of the securities of electric public utility companies in the market, the remarkable growth of demand for electric service and the efficiency with which that service is produced bear witness to the soundness of the industry as a whole and give assurance of a market for all the electricity the industry can produce for some years to come.

The Philadelphia Electric Company

By Joseph B. McCall
President

Outstanding Features of Its Organization, Service and Growth—Increased Efficiency of Operation Results in Great Savings to Public—Mammoth Station on Delaware to Care for Mounting Load

Independence Hall in Philadelphia

PHILADELPHIA, the third largest city in the United States in population, ranks third also in industrial production. The industrial establishments of Philadelphia in 1922 turned out products having a value of $1,653,281,300, which is an increase of 12.6 per cent over 1921. Exclusive of public service repair plants, Philadelphia in 1922 had a total of 6,583 industrial establishments, which gave employment to 278,591 persons, and these persons during 1922 received $299,313,300 in wages. There were in addition 43,908 salaried workers, who received a total of $94,467,300. Thus the salaried and wage employees in productive establishments in 1922 together numbered 322,499 and received in wages and salaries $393,780,600. The capital invested in the city's productive industrial plants in 1922 amounted to $1,032,443,100.

Philadelphia's industrial plants shipped products worth $810,540,800 to points outside of the city for sale and distribution. Thirteen and four-tenths of all taxable property in Pennsylvania is in Philadelphia, and 28.9 per cent of the total of the state's real estate value, or $2,491,815,175, is to be found there. The wholesale mercantile business of Pennsylvania in 1922 amounted to $1,356,770,738, while that of Philadelphia aggregated $644,001,700, or 45 per cent of the state's total. Retail mercantile business in the state in 1922 totaled $2,244,092,224, and of this total $658,323,400, or 29.3 per cent, was transacted in Philadelphia. The diversified manufactures in which the city is preeminent include locomotives, steel ships, street cars, textiles, hosiery, glazed kid, fur-felt hats, dental supplies, saws, storage batteries and bone buttons.

Territory of Company

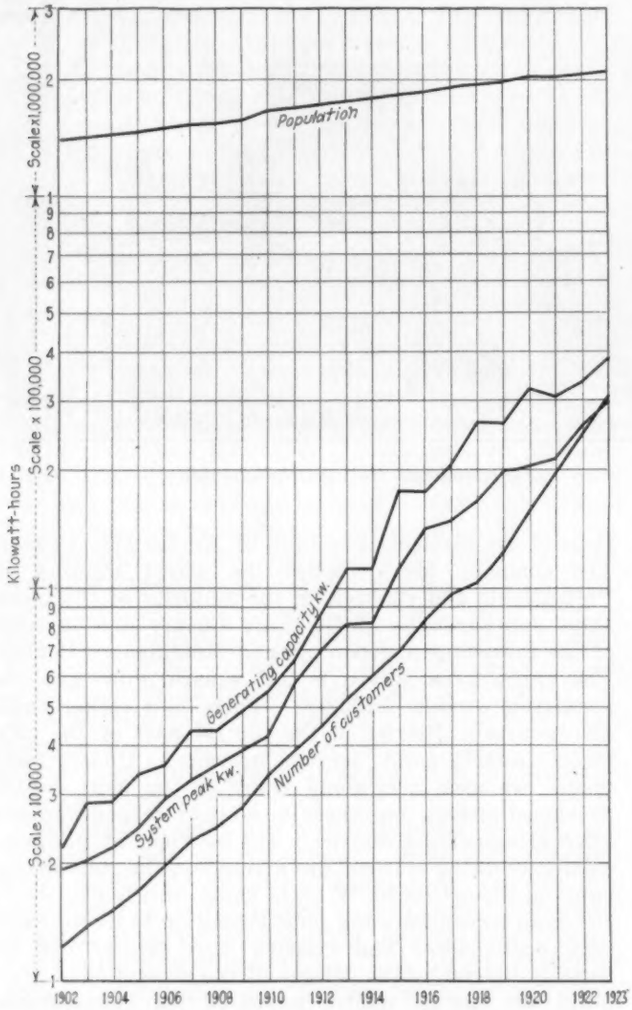
The Philadelphia Electric Company system furnishes the entire central-station electric light and power supply in Philadelphia, both city and county, and through its subsidiaries, the Delaware County Electric Company and the Bala & Merion Electric Company, supplies the entire commercial light and power business in the manufacturing and shipbuilding district southwest of Philadelphia, including the city of Chester and portions of the residential sections of Montgomery County. The company also supplies the street lighting in Philadelphia and Chester, in the majority of the townships and boroughs of Delaware County and in some of the townships and boroughs of Montgomery County. The entire area served is 245 square miles and the population exceeds 2,100,000. There is a rather small direct-current district in the central part of the city, where underground service prevails. Underground mains are used also along many of the more highly developed streets, but there is no definite underground alternating-current district. The locations of the principal generating stations are marked on the map accompanying the article by W. C. L. Eglin, which also shows the main substations and some belonging to large industrial customers. The relative load density can be roughly judged by the density of the substations.

All the electric motive power of the Pennsylvania Railroad is furnished by this company. The electrified sections are the Paoli Division, the Chestnut Hill Division and the West Jersey & Seashore Railroad line to Atlantic City. It is safe to say that the Pennsylvania Railroad Company is so wedded to the idea of central-station supply that additional electricity for transporting its cars will be purchased from the Philadelphia Electric Company or some other central-station company if electrification of other sections of the railroad is decided on.

The Philadelphia Electric Company supplies about 70 per cent of the electrical energy to operate the street-car system in Philadelphia. That would have been impossible some years ago, when it was generally thought to be a greater economy for the traction company to operate its own plant. This energy is transmitted direct to the busbars of the railway power houses and the traction company pays for the electricity delivered there and bears all the expense of its subsequent distribution.

In addition to its municipal service, 305,644 custom-

ers are supplied by the Philadelphia Electric Company. This figure is as of December 31, 1923. In the territory served in Philadelphia there are about 400,000 buildings. More than 60 per cent of these are two-story houses, some of which the electric company never expected to get as customers, but which within the past few years have been connected to the system. Ultimately they will all be connected, not only because of the convenience of electric illumination, but also because of the great use of household appliances which has become general throughout the country.



Growth of Company and of Population Served

In the table here printed and by means of graphs are shown some interesting historical data on the installed generating capacity of the Philadelphia Electric Company, the kilowatt-hours sold and other important matters. The figures strikingly represent how the company has grown since 1902, when such statistics were first available. They tell their own story.

How the Load Has Grown

The first organization in Philadelphia to supply electricity was an arc-lighting company which supplied street lighting and small commercial lighting in large units. This system was not adapted to any other use. With the invention of the Edison incandescent lamp other companies were organized. Philadelphia was originally a collection of villages which subsequently were incorporated into the city. In these numerous districts neighborhood lighting companies designed to give incandescent lighting service were inaugurated. The capacity of the stations of these companies was not equal to that of some of the smallest plants to be found in manufacturing buildings today. Hardly two of them were alike in construction and design or in the rates at which the public was served, and their unification was an involved matter on account of the necessary standardization of apparatus and rates.

In 1898, soon after a start to unite these companies had been made, the total station capacity in Philadelphia for electric power purposes was less than 20,000 kw., or one-nineteenth of the present rated capacity of 387,480 kw. While these numerous little neighborhood companies were all necessary, it was almost impossible to transmit energy outside of certain limited zones, except by incurring an extraordinary investment. In 1898 the company erected its first big generating station with a total capacity of 4,000 kw., which would have to be multiplied by 150 to equal the 600,000 kw. ultimate rating of the new Richmond station. This first station was connected with a rotary converter at the old Edison station and this was the first step which the company took toward the introduction of the alternating-current generator and connection with substations—the foundation of the great modern systems for transmission of electricity over a large territory.

The maximum load demand on the Philadelphia system last year was 300,000 kw. Sixty-four thousand new customers were added in 1923. In order to meet an even greater load demand and to care for many thousand additional customers this year and in coming years, the company plans a construction budget greater by one-third than the figures for 1923, involving the expenditure of nearly $19,500,000. Additions to the Delaware and Chester generating stations will fill them to capacity, and the Schuylkill stations are reaching their limit. The new generating station just alluded to is planned to take care of the heavy demand loads of the future. It will probably be the largest in the world, housing ultimately twelve 50,000-kw. turbo-generators, totaling 750,000 hp. This giant station will be known as Richmond and will be erected on the Delaware River at the foot of Wheatsheaf Lane, just below the Pennsylvania Railroad bridge. Actual construction work has already begun.

Transmission, substation and distribution facilities will be considerably increased in order that the additional energy required this year may be distributed. The central-station customers expect service day and night, and they want that service immediately. That is one of the reasons why these millions are being spent on new generating stations and substations and in extending the transmission and distribution systems.

Triple Rate Reduction

For the third time in three successive years the company announced on March 31 a reduction in rates, effective May 1, 1924, and estimated to amount to $1,300,000 annually. It will apply virtually to every type of service—residential, commercial and industrial. The reductions will mean that the company's customers will save this year more than $3,500,000 as compared with the rates which were in effect previous to May 1, 1922. The reduction in 1922 was $1,200,000 and that in 1923 was $1,080,000. As a result of these reductions the community will have saved more than $7,000,000 at the expiration of three years from the date of the first reduction. The three reductions in as many years establish a record in this country for a voluntary

GROWTH OF PHILADELPHIA ELECTRIC COMPANY IN TWENTY-TWO YEARS

The industrial plants in Delaware County in 1922 turned out products having a value of $168,320,000, of which the portion made in the city of Chester was valued at $62,932,700.

Years	Installed Generated Capacity, Kw.	System Peaks, Kw.	Kilowatt-Hours Generated	Area Served Sq. Miles	Population	No. of Customers	Kilowatt-Hours Sold
1902	21,928	19,101	54,089,356	171	1,400,518	12,090	45,581,476
1906	35,708	29,217	81,886,699	171	1,504,110	19,855	66,834,493
1911	65,486	57,940	148,281,042	245	1,699,338	38,651	115,257,079
1916	175,356	142,260	444,785,884	245	1,869,776	82,761	361,848,301
1921	306,230	213,570	877,047,595	245	2,020,555	196,260	756,899,083
1923	387,480	299,438	1,148,511,101	245	2,100,000	305,644	999,648,832

sharing of prosperity by a public utility with the community which it serves.

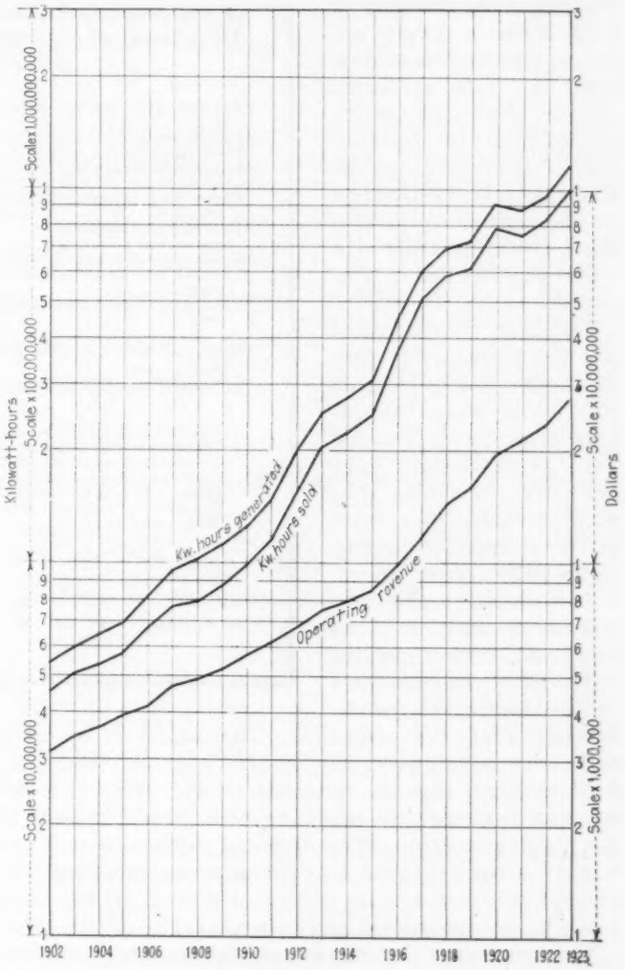
An energetic campaign to add unwired houses to the company's lines began in 1920, when 300,000 such residences, relics of the gas-lighting era, existed in Philadelphia. In less than four years this number has been cut in half. It is expected that at least 45,000 more old houses will be wired in 1924, and that in three or four years unwired houses will be reduced to negligible proportions and that Philadelphia's time-honored distinction as the "City of Homes" can be broadened to "City of Electric Homes."

Contact with the public is essential to the success of any public utility. The Philadelphia Electric Company has always made it a practice to associate itself with city and community activities. Our employees are members of the Chamber of Commerce, the Rotary and Kiwanis clubs and similar organizations, as well as of other business men's associations of various kinds. In this way the company has direct contact with the men behind industrial and mercantile enterprises in virtually every community in the area served. None of these bodies is political in character, and back of each one are civic pride and desire for achievement and development. There are many ways of getting and keeping in direct personal touch with customers. This is one of the most effective.

KEEPING IN TOUCH

The power service division and the residential survey division of the company play an important part in keeping it in close personal touch with the operating needs and troubles of its customers and in promoting the desire for better service. Industrial consumers are primarily in the business of producing and are prone to overlook such matters as proper motor installations, power-factor correction and load-cycle changes to improve operation. These things, involving also laboratory tests and data for competitive tests where an issue between a private plant and central-station service arises, are the care of the power service division. The residential survey division is constantly visiting both customers and non-customers, listening to complaints, suggesting improvements and giving advice to householders.

The growth of the company has naturally resulted in increased duties for all. Two years ago three new vice-presidents were added, so that today, in addition to the president and Walter H. Johnson, senior vice-president, the chief executives include Arthur B. Huey, vice-president in charge of the legal department; Charles J. Russell, vice-president in charge of the commercial department, and W. C. L. Eglin, vice-president in charge of the engineering department. Many of the burdens formerly carried by the president have been shifted to other shoulders. Mr. Johnson, as senior vice-president, is virtually the general manager of the organization and is responsible for the exercise of executive judgment not only in commercial affairs but also in matters of engineering policy. Mr. Huey, in addition to caring for legal matters, exercises general advisory functions. Mr. Russell is in charge of sales policies and their execution, as well as relations with



A Remarkable Increase in Company Activities Is Indicated

customers. Mr. Eglin is in direct charge of the engineering end of the business. The organization chart is reproduced.

The company's officials and employees participate actively in national societies and organizations. The president is a past-president of the National Electric Light Association and the Association of Edison Illuminating Companies, as well as being chairman of the national finance committee of the N. E. L. A. Mr. Johnson, in addition to being president of the N. E. L. A., is a past-president of the Association of Edison Illuminating Companies. Mr. Eglin is a past-president of the N. E. L. A. and also president of the Franklin Institute. Other executives and employees are chairmen of important committees in national organizations and are prominently identified with the work of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the Illuminating Engineering Society and other national societies.

It is a definite policy of the Philadelphia Electric Company to share its prosperity with three classes of

individuals whom it regards as its partners and who in their various ways make possible the successful operation of the utility. These three classes are its customers, its stockholders and its employees. In pursuance of this policy the company in 1922 made a triple announcement concerning, first, the rate reduction already described, which proved to be the forerunner in a series; second, an increase in the dividend on the common stock, and, third, the declaration of a wage dividend to employees.

The reduction in rates and the increase of stock dividends, noteworthy as they were, were happenings of a type not unusual with great electric light and power companies. The wage dividend has more of the element of novelty in the public utility world. It is designed to give substantial recognition to the loyal and efficient service rendered by the employees in contributing to the development of the company. The payment is made only from earnings of the system over and above all fixed charges, regular dividends on the preferred and common stock and the crediting of a proper amount to the surplus account. The dividend ranges from 2 per cent to 8 per cent, the rate being dependent upon the number of years' service of each employee. It has done much to stimulate loyal and eager service.

The employees' beneficial association has just completed its seventeenth year. During that period the receipts have been $915,173 and the expenditures $796,711, with a balance of $118,416 in cash and securities. During that time the beneficiaries of deceased employees have received $282,743.50; there have been paid out in disability benefits $405,215; in burial benefits (wives and dependent children) $10,603, and in welfare work $76,720. The average cost figures for a benefit of $1,000 has been $1.38 and for the seventeen-year period $23.44. Slightly over 75 per cent of the employees are members of the association, which was the first of its kind in the industry in this country.

There is also a service annuity plan, which, by the way, is not a pension plan. It covers something that cannot be figured on the payroll, and that is long, honest and loyal service to the corporation. Male employees can be placed on the service annuity roll at sixty-five and female employees at sixty. A satisfactory record of fifteen years of service qualifies a disabled employee to participate in the plan.

An athletic association enjoys the use of Howard McCall Field, named after the president's son and established in memory of him and fourteen other employees who died in France in the war year. This field contains 52 acres, and fourteen additional acres are leased. The ground includes a baseball field, tennis courts, a nine-hole golf course, children's playgrounds and an attractive club house and locker house.

Some Philadelphia Industrial Statistics

THE following table shows the value of products, the invested capital and the number of employees in the ten leading industries of Philadelphia, the figures, which are for 1922, being furnished by M. Hoke Gottschall, director Bureau of Statistics and Information, Pennsylvania State Department of Internal Affairs:

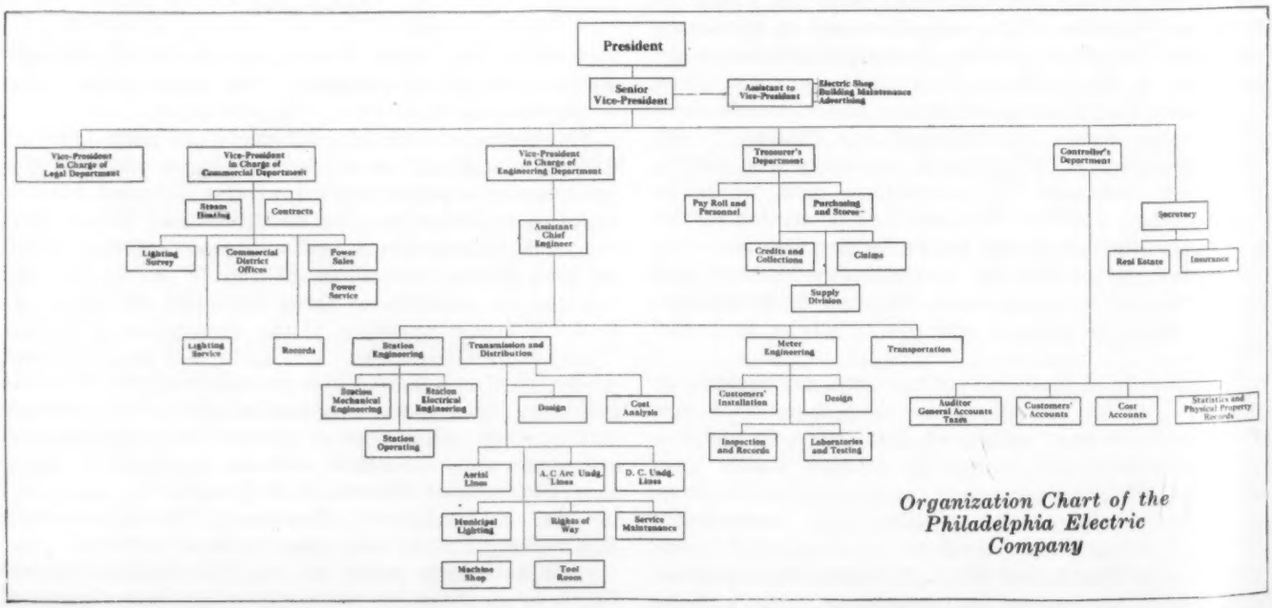
	Value of Products	Invested Capital	No. of Employees
Textiles and textile products	$455,639,000	$229,539,000	97,141
Metals and metal products	273,589,900	261,914,500	67,882
Food and kindred products	245,100,000	78,606,000	22,498
Chemicals and allied products	161,301,500	148,196,000	17,306
Paper and printing industries	157,776,200	115,304,000	30,890
Building and contracting	120,904,300	32,809,900	33,009
Leather and rubber goods	70,782,500	46,593,400	12,222
Tobacco and its products	41,807,200	12,792,900	7,725
Lumber and its remanufacture	32,043,700	17,839,000	7,786
Clay, glass and stone products	12,625,300	9,386,700	2,656

Some salient figures for Delaware County for 1922 follow:

Employees	35,466
Total industrial payroll	$109,504,100

	Value of Products
Textiles and textile products	$73,308,100
Chemicals and allied products	32,235,100
Metals and metal products	31,503,200
Food and kindred products	2,719,100
Paper and printing industries	3,919,200
Building and contracting	5,902,000
Mines and quarries	3,526,900

The industrial plants in Delaware County in 1922 turned out products having a value of $168,320,000, of which the portion made in the city of Chester was valued at $52,932,700.



Organization Chart of the Philadelphia Electric Company

The Financial Structure of Power and Light Companies

By Alfred L. Loomis
Vice-President Bonbright & Company, Inc.
New York, N. Y.

Adequate Financial Structures Are Necessary to Insure Full and Unhampered Growth of Electrical Utility Industry — Newly Segregated Financial Data Have Been Tabulated and Are Analyzed to Show Present Practice and Tendencies

THE power and light industry represents today an investment of more than $5,800,000,000. During the last ten years it has more than doubled. Careful estimates indicate that during the next ten it will again more than double. On the average, therefore, the power and light companies must be ready each year to add to their capital investment 10 per cent of their present total.

Some of the older financial structures did not at the outset take sufficient cognizance of the tremendous demands that would be made upon the industry. In a few cases the structures were so rigid that the companies were caught in a vicious circle. They could not raise sufficient new money to meet their constantly increasing demands and were forced to curtail expenditures and reduce dividends. Their service as a result became inadequate. This caused them to get into local difficulties, which in turn reflected upon their credit and made more difficult the raising of new money. Fortunately, however, the great majority of the companies followed the cycle in just the opposite way. They were able to raise sufficient money on advantageous terms; they gave good service, which in turn tended to increase their popularity and credit and made the raising of funds increasingly easy each year as demands for expansion arose.

Today the importance of a financial structure adequate to keep pace with the demands for expansion is fully appreciated by the industry as a whole. More and more thought is being given this subject by company executives, and a brief survey of conditions as they now exist must accordingly be of interest.

Tabulation of Companies

A table showing the capitalization and earnings of eighty-four companies has been prepared and appears herewith. This table is believed to include all operating power and light companies which did a gross business in 1923 of more than $1,500,000. Only such companies are included as derived at least 80 per cent of their gross income from the sale of electricity. Certain companies, therefore, that did a large gas or street-railway business in addition to electric light and power have been excluded.

From this table a sort of "financial cross-section" of the industry may be obtained. The gross income of these eighty-four companies was more than $670,000,000, or approximately half of that of the entire industry. Their combined total capitalization is over $3,000,000,000, or about 55 per cent of that of the industry.

Before discussing this table in detail two general types of financial structures should be considered. In those states in which the commissions have not limited the amount of dividends but have considered solely the amount that companies will be permitted to earn upon the value of their properties the first general type of financing has become prevalent. Consider a theoretical company operating in such a state:

Value of property	$10,000,000
Capitalization:	
Bonds	6,000,000
Preferred stock	2,000,000
Common stock	2,000,000
Allowable net earnings (8 per cent)	800,000
Interest charges (6 per cent)	360,000
Balance	440,000
Preferred dividend (7 per cent)	140,000
Common dividend (10 per cent)	200,000
Balance to surplus	100,000

Companies financed in approximately this ratio should have no trouble raising new money and can pay 10 per cent to their common stockholders and carry a substantial sum to surplus even though the property as a whole is permitted to earn only 8 per cent. Low prior charges make possible a relatively high return on the common stock, but it is equally true that unless there is a sufficiently high return on the common it is difficult to sell junior securities, without which it is impossible to have low charges on the senior securities.

The second type of financing has prevailed in certain New England states where the commissions are loath to permit increases in dividend rates and where the holders of the capital stocks are loath to see charges put ahead of their stock. In these states many of the companies have financed themselves by issuing from time to time additional amounts of capital stock. Although the stockholders do not get an increase in dividends, they receive valuable rights to subscribe to new stock, and as these rights can be sold they thus indirectly secure additional income. Consider a hypothetical company of this type:

Value of property	$10,000,000
Capitalization:	
Capital stock	5,000,000
Surplus	5,000,000
Allowable earnings (8 per cent)	800,000
Dividends (12 per cent)	600,000
Balance to surplus	200,000

Table of Power and Light Companies with

Includes only companies where at least 80 per cent of the

	Company	CAPITALIZATION				
		Funded Debt	Preferred	Common	Surplus	Total
1	New York Edison Co. System (*Consolidated Gas Co.*)	$68,220,000	$2,000	$100,741,000	$60,090,000	$229,053,000
2	Commonwealth Edison Co	74,774,000	None	72,000,000	12,703,000	159,477,000
3	Detroit Edison Co	68,810,000	None	43,405,000	4,209,000	116,424,000
4	Public Service Electric Co. (*Public Service Corp'n of N. J.*)	3,143,000	None	42,250,000	6,681,000	52,074,000
5	Philadelphia Electric Co	68,022,000	8,189,000	47,069,000	10,500,000	133,780,000
6	Brooklyn Edison Co	30,746,000	None	43,704,000	5,577,000	80,027,000
7	Southern California Edison Co	102,157,000	15,236,000	46,388,000	3,393,000	167,174,000
8	Duquesne Light Co. (*Philadelphia Company*)	31,728,000	25,000,000	18,226,000	5,638,000	80,592,000
9	Edison Electric Illuminating Co. of Boston	13,250,000	None	32,440,000	22,001,000	67,691,000
10	Cleveland Electric Illuminating Co. (*North American Co.*)	23,500,000	5,655,000	15,045,000	5,707,000	49,907,000
	Total—Companies 1-10 inclusive	$484,350,000	$54,082,000			$1,136,199,000
11	Consumers Power Co. (*Commonwealth Power Corp.*)	$44,579,000	$21,566,000	$16,404,000	$1,645,000	$84,194,000
12	Northern States Power Co. (*Standard Gas and Electric Co.*)	59,653,000	33,667,000	6,170,000	2,423,000	101,913,000
13	Penna. Power & Light Co. (*Lehigh Power Securities Corp.*)	36,000,000	22,343,000	*345,819 shs*	3,424,000	61,767,000
14	Union Electric Light & Power Co. (St. Louis) (*North American Co.*)	20,503,000	9,002,000	*620,000 shs*	4,242,000	33,747,000
15	West Penn Power Co. (*American Water Works & Electric Co.*)	38,953,000	10,139,000	14,100,000	782,000	63,954,000
16	Ohio Power Co. (*American Gas & Electric Co.*)	29,761,000	4,240,000	4,951,000	.....	38,952,000
17	Southern Power Co	7,000,000	6,000,000	4,800,000	945,000	18,745,000
18	Buffalo General Electric Co	10,838,000	None	13,856,000	4,251,000	28,945,000
19	Kansas City Power & Light Co. (*Continental Gas & Electric Corp.*)	21,300,000	10,000,000	*250,000 shs*	4,787,000	40,724,000
20	Utah Power & Light Co. (*Utah Securities Corp.*)	36,847,000	15,556,000	30,000,000	1,603,000	84,006,000
	Total—Companies 11-20 inclusive	$305,434,000	$132,513,000			$556,947,000
21	Montana Power Co	$34,059,000	$9,784,000	$49,633,000	$4,538,000	$98,014,000
22	Metropolitan Edison Co. (*General Gas & Electric Co.*)	26,816,000	6,506,000	*95,554 shs*	2,256,000	38,996,000
23	Alabama Power Co. (*Alabama Traction, Light & Power Co., Ltd.*)	46,356,000	6,225,000	18,751,000	1,294,000	72,626,000
24	Ohio Public Service Co. (*Cities Service Co.*)	17,189,000	4,500,000	5,000,000	988,000	22,677,000
25	Niagara Falls Power Co.	37,569,000	16,307,000	17,851,000	3,782,000	75,509,000
26	New England Power Co. System (*New England Co.*)	20,995,000	12,323,000	6,500,000	678,000	40,496,000
27	Great Western Power Co	42,263,000	7,755,000	27,500,000	5,037,000	86,555,000
28	Adirondack Power & Light Co	18,465,000	7,912,000	9,243,000	2,002,000	37,622,000
29	Narragansett Electric Lighting Co	None	None	16,320,000	709,000	17,029,000
*30	Penn Public Service Corp	23,594,000	6,509,000	4,160,000	.....	34,263,000
	Total—Companies 21-30 inclusive	$267,306,000	$77,821,000			$523,787,000
31	Central Indiana Power Co. (*American Public Utilities Co.*)	$22,254,000	$6,250,000	$5,500,000	.....	$34,004,000
32	Potomac Electric Power Co. (*Washington Ry. & Electric Co.*)	13,691,000	250,000	5,750,000	$1,347,000	21,038,000
33	Texas Power & Light Co. (*American Power & Light Co.*)	12,205,000	4,500,000	10,000,000	862,000	27,567,000
34	Niagara, Lockport & Ontario Power Co	19,031,000	1,999,000	*199,618 shs*	1,468,000	28,817,000
35	Connecticut Light & Power Co	7,364,000	11,000,000	8,486,000	631,000	27,481,000
36	Pennsylvania-Ohio Power & Light Co. (*Penn-Ohio Edison Co.*)	19,229,000	4,128,000	6,000,000	522,000	29,879,000
*37	N. Y. & Queens Electric Light & Power Co. (*Consolidated Gas Co.*)	2,350,000	1,250,000	8,350,000	3,546,000	15,496,000
38	Washington Water Power Co	10,251,000	None	20,197,000	95,000	30,543,000
39	Dayton Power & Light Co	10,974,000	5,000,000	3,053,000	1,116,000	20,143,000
40	Scranton Electric Co. (*American Gas & Electric Co.*)	7,249,000	2,859,000	2,500,000	.....	12,608,000
	Total—Companies 31-40 inclusive	$124,598,000	$37,236,000			$247,576,000
*1	Hartford Electric Light Co	$3,000,000	$2,000,000	$10,000,000	$1,269,000	$16,269,000
42	United Illuminating Co. (New Haven)	1,625,000	None	7,843,000	2,577,000	12,045,000
43	Indianapolis Light & Heat Co	4,228,000	None	3,782,000	198,000	8,268,000
44	Nevada-California Electric Co	17,837,000	9,258,000	8,418,000	2,721,000	38,234,000
45	Nebraska Power Co. (*American Power & Light Co.*)	11,050,000	4,000,000	5,000,000	513,000	20,563,000
46	Central Illinois Light Co. (*Commonwealth Power Corp.*)	8,213,000	4,504,000	5,000,000	433,000	18,250,000
47	Indiana & Michigan Electric Co. (*American Gas & Electric Co.*)	5,959,000	1,549,000	3,601,000	.....	11,109,000
48	Appalachian Power Co	14,114,000	6,072,000	*60,000 shs*	754,000	25,414,000
*49	Central Maine Power Co	14,443,000	6,760,000	2,500,000	424,000	24,127,000
50	Pennsylvania Edison Co. (*General Gas & Electric Co.*)	7,876,000	1,977,000	*25,254 shs*	453,000	12,817,000
	Total—Companies 41-50 inclusive	$88,345,000	$36,120,000			$187,096,000
51	Worcester Electric Light Co	None	None	$2,400,000	$2,944,000	$5,344,000
52	United Electric Light Co. (Mass.)	$1,000,000	None	3,200,000	2,643,000	6,843,000
53	Dallas Power & Light Co	8,100,000	$2,000,000	2,000,000	305,000	12,405,000
54	Fort Worth Power & Light Co. (*American Power & Light Co.*)	3,490,000	1,779,000	4,174,000	404,000	9,847,000
55	Mississippi River Power Co	21,712,000	8,232,000	16,000,000	1,298,000	47,242,000
56	Long Island Lighting Co	7,531,000	3,352,000	2,000,000	1,249,000	14,132,000
57	Empire District Electric Co. (*Cities Service Co.*)	5,677,000	1,467,000	3,000,000	.....	10,144,000
58	Des Moines Electric Co. (*Illinois Power & Light Co.*)	4,981,000	300,000	1,000,000	.....	6,281,000
59	Western States Gas & Electric Co. (*Standard Gas & Electric Co.*)	10,308,000	3,248,000	3,231,000	167,000	16,954,000
60	Kentucky & West Virginia Power Co. (*American Gas & Elec. Co.*)	4,860,000	2,000,000	2,097,000	.....	8,957,000
	Total—Companies 51-60 inclusive	$67,659,000	$22,378,000			$138,149,000
*61	Penn Central Light & Power Co	$5,898,000	$3,305,000	$1,528,000	$871,000	$11,602,000
62	Minnesota Power & Light Co. (*American Power & Light Co.*)	11,700,000	9,150,000	20,000,000	1,098,000	41,948,000
63	Virginian Power Co	8,655,000	1,200,000	5,000,000	187,000	15,042,000
64	Idaho Power Co. (*Power Securities Corp.*)	12,200,000	3,176,000	15,000,000	1,018,000	31,394,000
65	Houston Lighting & Power Co. (*National Power & Light Co.*)	6,403,000	2,000,000	2,500,000	233,000	11,136,000
66	Indiana General Service Co. (*American Gas & Electric Co.*)	4,281,000	614,000	3,000,000	.....	7,895,000
67	Illinois Northern Utilities Co. (*Middle West Utilities Co.*)	6,769,000	3,664,000	4,635,000	497,000	15,565,000
68	Turners Falls Power & Electric Co	3,900,000	None	9,657,000	352,000	13,909,000
69	Tampa Electric Co	919,000	None	4,140,000	.....	5,059,000
70	Pennsylvania Water & Power Co	13,878,000	None	9,769,000	1,355,000	25,002,000
	Total—Companies 61-70 inclusive	$73,703,000	$23,109,000			$177,652,000
71	Northwestern Electric Co	$6,900,000	$3,182,000	$10,000,000	$1,028,000	$21,110,000
72	Atlantic City Electric Co. (*American Gas & Electric Co.*)	2,747,000	1,191,000	1,250,000	.....	5,188,000
73	Connecticut Power Co	3,149,000	1,250,000	2,250,000	484,000	7,133,000
74	Fall River Electric Light Co	None	None	3,550,000	934,000	4,384,000
75	Yadkin River Power Co. (*Carolina Power & Light Co.*)	7,500,000	1,659,000	3,835,000	952,000	13,946,000
76	Northern N. Y. Utilities Co	8,442,000	4,278,000	1,840,000	442,000	15,002,000
77	Harrisburg Light & Power Co. (*United Gas & Electric Corp.*)	5,024,000	1,250,000	2,000,000	101,000	8,375,000
78	Wheeling Electric Co. (*American Gas & Electric Co.*)	2,284,000	1,000,000	1,000,000	.....	4,284,000
79	Lowell Electric Light Co	None	None	2,650,000	1,602,000	4,152,000
80	Edison Electric Illuminating Co. of Brockton	200,000	None	2,583,000	910,000	3,693,000
	Total—Companies 71-80 inclusive	$36,246,000	$13,810,000			$87,267,000
81	Rockford Electric Co. (*American Gas & Electric Co.*)	$1,595,000	$439,000	$1,500,000	.....	$3,534,000
82	Arkansas Light & Power Co	6,723,000	2,129,000	3,790,000	.....	12,642,000
*83	Eastern Connecticut Power Co	3,000,000	4,000,000	3,000,000	$538,000	10,538,000
*84	Cambridge Electric Light Co	None	None	1,300,000	450,000	1,750,000
	Total—Companies 81-84 inclusive	$11,318,000	$6,568,000			$28,464,000
	Grand total	$1,458,959,000	$403,637,000			$3,083,137,000

NOTE.—The annual reports for 1923 were examined wherever available. Data on certain of the other companies were obtained from the companies directly or from other sources. In the case of companies indicated by (*) it was not possible to get 1923 figures and therefore those for 1922 were used. This is to be regretted, but it was unavoidable.

Where the common stock of a company is owned by another company the name of that other company is given in italics. The gross income includes non-operating as well as operating income. Net earnings are after depreciation. In the case of certain companies that have not reported the amount charged to depreciation an arbitrary sum equal to 5 per cent of their gross income has been thus charged, so as

Gross Earnings of $1,500,000 and Over

gross income was derived from the sale of electricity

Gross Earnings	1923 EARNINGS Net Earnings	Interest	Times Earned	Preferred Dividends	Times Earned	Generating Capacity in Kw. 000 Omitted	Peak Load in Kw. 000 Omitted	Average Load in Kw. 000 Omitted	Percentage Purchased Energy to Total Output	1923 Percentage Energy Sold to Total Output	Electric Power and Light Customers
$62,714,000	$25,431,000	$10,931,000	2.3	130	....	698	555	217	0	84	617,000
49,693,000	10,604,000	3,052,000	3.4	None	....	663	624	293	1	88	688,000
31,724,000	9,359,000	3,867,000	2.4	None	....	359	303	155	0	83	376,000
31,318,000	9,866,000	3,143,000	3.1	None	....	367	282	122	3	79	426,000
28,022,000	10,409,000	3,604,000	2.8	$798,000	7.7	387	299	135	0	87	241,000
23,422,000	7,670,000	1,817,000	4.2	None	....	189	180	68	5	74	356,000
20,211,000	9,319,000	3,070,000	3.0	830,000	5.9	372	312	173	6	77	248,000
20,179,000	7,586,000	2,579,000	2.9	1,362,000	3.5	267	219	119	5	85	187,000
17,888,000	5,626,000	1,305,000	4.3	None	....	203	153	60	3	76	205,000
17,712,000	6,120,000	1,287,000	4.7	340,000	13.7	246	187	91	0	87	214,000
$302,883,000	$101,990,000	$34,655,000									
$16,887,000	$6,653,000	$2,032,000	3.2	1,172,000	3.7	203	139	65	6	77	185,000
15,489,000	5,931,000	2,345,000	2.5	2,161,000	1.6	148	149	72	1	79	209,000
14,667,000	6,069,000	1,689,000	3.6	1,476,000	3.0	157	103	68	15	88	125,000
14,424,000	4,934,000	1,094,000	4.5	606,000	6.3	182	154	74	43	88	186,000
12,950,000	4,651,000	1,530,000	3.0	518,000	5.1	254	181	108	0	84	83,000
11,087,000	3,906,000	1,758,000	2.2	254,000	8.3	128	...	...	..	..	83,000
8,991,000	1,297,000	275,000	4.7	420,000	2.4	417	270	114	8	81	415
8,970,000	2,686,000	594,000	4.5	None	....	95	154	81	73	86	129,000
8,861,000	3,233,000	947,000	3.4	700,000	3.0	116	62	34	0	84	104,000
8,727,000	4,474,000	2,049,000	2.2	1,085,000	2.2	167	105	71	1	85	84,000
$121,053,000	$43,834,000	$14,313,000									
$8,169,000	$4,809,000	$1,617,000	2.9	685,000	44.	213	156	128	0	86	43,000
8,045,000	2,632,000	1,226,000	2.1	508,000	2.7	72	41	19	13	86	65,000
7,863,000	3,585,000	1,467,000	2.4	341,000	6.5	126	178	87	0	82	31,000
7,768,000	2,966,000	913,000	3.2	315,000	6.5	116	92	47	18	91	40,000
7,593,000	4,271,000	1,709,000	2.4	1,107,000	2.3	402	356	296	0	93	.....
7,468,000	1,769,000	736,000	2.4	714,000	1.4	85	139	65	53	86	85
7,214,000	4,375,000	2,631,000	1.6	904,000	1.6	144	116	65	2	70	48,000
6,902,000	1,999,000	1,079,000	1.8	538,000	1.6	97	82	43	21	82	60,000
6,636,000	1,756,000	160,000	....	None	....	125	88	42	4	79	71,000
6,417,000	2,821,000	1,514,000	1.8	440,000	2.9	74	57	20	0	82	60,000
$74,075,000	$30,983,000	$13,052,000									
$6,406,000	$2,197,000	$1,409,000	1.5	437,000	1.8	7	...	...	..	..	.....
5,972,000	2,154,000	1,017,000	2.1	25,000	45.4	101	70	30	0	83	63,000
5,659,000	2,053,000	706,000	2.9	315,000	5.2	25	38	26	68	83	55,000
5,597,000	1,995,000	898,000	2.2	123,000	7.6	66	142	80	77	87	21,000
5,593,000	2,118,000	941,000	2.2	719,000	1.7	47	50	22	34	80	44,000
5,577,000	2,372,000	1,347,000	1.7	295,000	3.4	78	61	38	2	90	59,000
5,536,000	1,571,000	499,000	3.1	62,000	17.2	24	40	16	98	83	89,000
5,406,000	2,224,000	607,000	3.6	None	....	105	86	46	2	82	45,000
5,166,000	1,869,000	554,000	3.3	267,000	4.5	82	53	22	0	85	60,000
4,952,000	1,927,000	451,000	4.3	141,000	10.4	49	...	...	..	..	50,000
$55,864,000	$20,480,000	$8,429,000									
$4,880,000	$1,725,000	$277,000	6.2	64,000	22.6	78	60	20	3	90	48,000
4,833,000	1,011,000	110,000	9.2	None	....	45	...	...	..	..	37,000
4,562,000	1,934,000	206,000	9.3	None	....	60	39	19	0	78	.....
4,163,000	1,840,000	1,014,000	1.8	513,000	1.6	60	40	25	6	72	18,000
3,886,000	1,516,000	658,000	2.3	280,000	3.7	53	34	18	0	89	50,000
3,520,000	1,226,000	434,000	2.8	266,000	2.9	33	...	...	..	..	32,000
3,507,000	873,000	312,000	2.8	125,000	4.5	42	37	17	0	82	34,000
3,457,000	1,336,000	656,000	2.0	396,000	1.4	68	47	28	0	90	12,000
3,342,000	1,466,000	931,000	1.5	405,000	1.2	47	32	16	9	76	.....
3,192,000	1,059,000	398,000	2.6	158,000	3.8	37	...	...	..	..	29,000
$39,342,000	$13,986,000	$4,996,000									
$3,188,000	$799,000	$4,000	....	None	....	56	34	12	10	89	40,000
3,152,000	1,230,000	88,000	13.9	None	....	45	86	...	..	..	30,000
3,096,000	1,210,000	453,000	2.6	109,000	6.8	15	16	12	48	88	44,000
3,043,000	1,164,000	224,000	5.1	124,000	8.8	44	45	25	0	91	26,000
3,017,000	2,254,000	1,201,000	1.8	494,000	2.1	111	129	72	1	90	27
2,979,000	1,376,000	516,000	2.6	141,000	5.5	25	...	...	..	..	40,000
2,784,000	997,000	466,000	2.1	88,000	6.0	52	58	17	16	81	.....
2,768,000	984,000	362,000	2.7	16,000	38.8	31	...	...	..	..	23,000
2,697,000	729,000	464,000	1.5	214,000	1.2	...	...	...	..	..	32,000
2,674,000	959,000	628,000	1.5	160,000	2.1	57	...	...	..	..	5,000
$29,398,000	$11,702,000	$4,406,000									
$2,670,000	$778,000	$358,000	2.1	179,000	2.3	30	36	16	1	78	33,000
2,659,000	1,305,000	278,000	4.7	225,000	4.6	77	...	...	..	..	36,000
2,631,000	804,000	449,000	1.7	None	....	53	...	...	0	92	.....
2,609,000	1,179,000	765,000	1.5	142,000	4.3	60	40	25	19	75	40,000
2,603,000	941,000	249,000	3.8	91,000	7.6	32	27	14	0	85	41,000
2,485,000	680,000	263,000	2.6	37,000	11.3	31	71	...	..	..	30,000
2,344,000	855,000	407,000	2.1	214,000	2.0	10	...	...	..	..	32,000
2,270,000	764,000	158,000	4.8	None	....	75	59	24	11	88	40,000
2,147,000	924,000	66,000	14.0	None	....	..	...	...	..	..	.....
2,124,000	1,355,000	548,000	2.4	None	....	36	85	48	0	88	.....
$24,542,000	$9,585,000	$3,541,000									
$2,043,000	$967,000	$403,000	2.4	184,000	3.0	28	30	17	14	78	.....
2,018,000	439,000	198,000	2.2	71,000	3.4	31	...	...	..	..	20,000
1,995,000	628,000	210,000	2.9	75,000	5.5	40	...	...	..	..	14,000
1,965,000	524,000	31,000	....	None	....	15	...	...	..	..	17,000
1,956,000	1,021,000	420,000	2.4	110,000	5.5	25	49	26	38	80	12,000
1,901,000	1,106,000	447,000	2.4	233,000	1.8	31	...	...	..	..	12,000
1,823,000	581,000	278,000	2.0	75,000	4.0	5	...	...	..	..	20,000
1,781,000	297,000	121,000	2.4	50,000	3.5	8	...	...	..	..	16,000
1,617,000	460,000	9,000	....	None	....	21	...	...	..	..	15,000
1,583,000	476,000	12,000	39.6	None	....	17	...	...	..	..	21,000
$18,682,000	$6,302,000	$2,547,000									
$1,523,000	$333,000	$119,000	2.8	26,000	8.1	21	...	...	..	..	18,000
1,500,000	659,000	254,000	2.5	149,000	2.7	17	...	...	..	..	17,000
1,440,000	481,000	150,000	3.2	255,000	1.3	32	...	...	..	..	.....
1,412,000	361,000	39,000	....	None	....	...	...	...	..	..	14,000
$5,875,000	$1,834,000	$562,000									
$671,714,000	$240,696,000	$86,501,000									

to make their figures comparable with the other companies. The item "interest" includes rentals paid but does not include "sinking fund" or "amortization of debt" charges. As there is no uniform system of accounting among power and light companies, it has been necessary to analyze the reports and rearrange items so that the figures will be on an approximately comparable basis. It is inevitable that there will be a certain number of errors in the table, but it must be borne in mind that the primary purpose of preparing this table is not to analyze any one company, but to arrive at certain general facts regarding the companies as a group. Thus slight errors in the figures of one company will not materially affect the aggregate figures.

Assume that the stock of this company has been paying 12 per cent for years (6 per cent on the value of the property) and is selling at slightly more than $200 per share. Suppose each year this company raised an additional $800,000 by offering 5,000 shares to its stockholders at $160 a share. If the old stock is selling in the market at $204, each "right" ought to have a value of approximately $4, and thus in effect the stockholders will receive a return of 16 per cent on the par value of their stock or 8 per cent on the value of the property.

Turning to the table, the reader can readily identify certain companies typical of each type. Many others are intermediate between the two types. Five companies typical of each are analyzed below:

	Per Cent of Capitalization			
	Bonds	Pfd. Stk.	Com.Stk.	Surp.
First type—five companies	48	27	20	5
Second type—five companies	15	0	57	28
	Per Cent of Net Income			
	Int.	Pfd. Div.	Com. Div.	Surp.
First type—five companies	37	19	29	15
Second type—five companies	16	0	63	21

The first type is undoubtedly gaining in favor. Under it a company is in a position to sell preferred stock to its customers. This advantage cannot be overemphasized. Furthermore, in territories where the growth is very rapid it permits the raising of large sums from investors all over the country. The second type has been used chiefly in the older communities in New England, where there have been local investors of sufficient wealth to supply the money necessary for new construction.

Now pass to the details of the financial structure of the various companies given in the table.

Mortgage Bonds.—It has become an almost universal custom during the last decade for power and light companies to issue only "open-end" mortgages, which provide that from time to time additional bonds may be issued against new construction. This is in sharp contrast with the older method of financing, in which mortgages were closed and new money could be raised only by the issuance of junior securities. The terms of these new "open-end" mortgages have become generally standardized. They usually permit bonds to be issued for 75 per cent of the cost of new construction (this figure varies from 70 per cent to 80 per cent) but only when the company has earned its bond interest twice during the preceding year; they also permit bonds to be issued, par for par, to retire underlying bonds.

Ten years ago it was customary to insert in every mortgage a sinking-fund provision. Since in an industry that must constantly expand such provisions often work great hardship, they have been very generally abandoned. In their place have been inserted provisions that require the establishment of a fund to be used for maintenance and improvement, against which new bonds cannot be issued.

Where extensions to existing service have involved the building of large new power plants, an interesting method of financing their construction has been rather extensively used during the last few years. A separate "power-manufacturing company" is organized. This sells its own securities and with the proceeds builds the plant. It either leases its property to a distributing company for operation or contracts with one or more distributing companies to take its entire output. Certain keen observers of the industry believe that this method of differentiating between the ownership of "power-manufacturing companies" and "distributing companies" will become more and more marked as "interconnection" proceeds and generating stations become larger and serve wider territories.

The eighty-four companies listed in the table have in the aggregate 292 separate issues of bonds and notes totaling $1,458,000,000. At present market quotations the average yield on these 292 issues is 6.12. If only issues of $10,000,000 and over and maturing in not less than five years (forty-one issues) are considered the average yield is 5.71 per cent. The table shows another interesting fact. The aggregate net earnings of the companies as a whole are two and eight-tenths times the aggregate interest charges.

Debenture Bonds.—A recent development of power and light financing has been the issuing of long-term debenture bonds by certain companies having a high credit standing. Assume that such a company would normally finance its new construction through the sale, in definite proportion, of mortgage bonds, preferred stock and common stock. Such a company keeps in its treasury a certain amount of its mortgage bonds which have been issued against new construction and sells debenture bonds in their place. The debentures, it is true, cost such a company slightly more than would the mortgage bonds, but the company looks upon this additional cost as an insurance premium, a certain amount of the company's senior securities remaining free in its treasury to be used during periods of financial stress for short-term loans or for other purposes. The same result could, of course, be accomplished by putting out additional preferred stock (in addition to what would normally be issued), but such stock, costing the company even more, would make the "insurance premium" that much larger.

Preferred Stocks.—Of the eighty-four companies in the table, sixty-five have preferred stocks aggregating $400,000,000. At present market quotations these stocks show an average yield of 7.38 per cent. In the aggregate their dividends are earned two and six-tenths times.

Of these sixty-five companies forty-nine have sold part of their preferred stocks to customers and employees. To touch upon the many advantageous results that flow from having the customers of a company "partners" in the enterprise is unnecessary in this article. It is sufficient to say that of the $400,000,000 of preferred stock listed in the table it is estimated that more than half are now held by local customers and employees.

Common Stocks.—The table shows that the common stocks of forty-one of the companies out of the eighty-four are owned by other companies. These other companies may be divided into three general groups:

(a) Companies that conduct other business besides electricity—in most cases a gas or street-railway business.

(b) Companies that may be called "diversity holding companies," which own the common stocks of a group of power and light companies operating in different parts of the country. Such companies offer the investor a diversity of risk that would not be obtained by the ownership of stock in a single company. Many of these companies in addition

OWNERSHIP OF THE COMMON STOCKS OF POWER AND LIGHT COMPANIES

	Owned by the Public	Owned by Gas and Similar Companies	Owned by "Diversity Holding Companies"	Owned by "Finance Companies"
No. of companies	43	8	28	5
Capitalization*	$1,588	$460	$743	$230
Gross*	321	141	166	41

*Expressed in millions of dollars.

offer a unified system of management for the constituent companies.

(c) A third group may be called "finance companies," organized solely to finance the organization or acquire the stock of a particular power and light company. This type is rapidly disappearing. Only five appear in the table.

The industry has become so important and supplies such a vital economic necessity that adequate capital will certainly be available to meet all demands. Millions of small investors are putting their savings into the industry. The industry is thus becoming truly "publicly owned." Governmental, state or municipal aid is neither necessary nor advisable. Private capital can build "superstations" and long transmission lines as well as distributing systems. Other great "reservoirs of capital," such as insurance companies, savings banks and educational institutions, are tending to put more and more of their funds into the industry. There is everything to confirm the belief that as this trend continues the high-grade securities of the power and light industry will gradually sell as high as or even higher than similar railroad securities.

ADDENDA: Certain operating data have been added to the table in addition to the financial data so that the reader can obtain a general idea of the kind of business done by each company:

(a) "Average load" has been obtained by dividing the entire year's output expressed in kilowatt-hours by 8,760, the number of hours in a year. The resulting figure can be compared with the "peak-load" figure and the ratio gives the annual "load factor." The average for all companies for which there are data shows an average load factor of 50.85 per cent; the average for the ten largest companies is 46.02 per cent.

(b) "Percentage of energy purchased" gives an indication as to whether a company is a self-contained unit or is more of a distributing company, obtaining power from outside sources.

(c) "Number of customers" compared with the average load shows whether or not a company has a large percentage of wholesale customers. The average for all the companies for which there are data shows an average load of 515 watts per customer.

The Engineering Features of the Philadelphia Electric Company System

By W. C. L. Eglin
Vice-President in Charge of Engineering

THE engineering problems involved in the development of the Philadelphia Electric Company's system arose originally from the necessity of consolidating and combining the generating and distributing systems of twenty-six separate companies whose plants and distributing systems contained practically all of the known methods of distribution of that date—namely, about 1895—several scattered direct-current networks, and constant-current circuits supplying street and commercial arcs and constant-current series motors and lamps.

The first step was the standardization of the essential features. The secondary voltage was standardized at 115, the Edison standard base or screw socket was adopted, and twenty-four-hour service was established throughout the system; also the series arcs were rapidly eliminated from commercial service and low-voltage inclosed arcs operated from the constant-potential mains were substituted. Motors and series lamps operating on arc circuits were also eliminated.

A more serious problem was the number of existing frequencies. Most of the generating stations were operated at different frequencies, even individual stations having in some cases two or more, and practically all of the generators were belt-driven. A standard frequency of 60 cycles was adopted, and direct-connected alternators were substituted for the belt-driven generators. Many difficulties developed which had to be overcome, such as the operation of rotary converters from engine-driven 60-cycle alternators. This led to the development of dampers on the poles, which eliminated "hunting" and made the 60-cycle rotary converter commercially successful.

As most of the individual distributing systems made use of either single-phase or three-wire, two-phase methods, the 6,000-volt, two-phase system was adopted at the generating stations with 2,300 volts at the substation. In the substations dial switches were used on the transformers so as to permit of variations in the voltage at the substation independent of the voltage at the generating stations. Later the alternating-current substations were furnished with automatic regulators, obviating the necessity of dial switches on the transformers.

The standard system adopted for distributing throughout the entire area used alternating current, but at the beginning there were a number of scattered areas where there were small direct-current networks distributing both at 110-220 volts, three-wire, and at 500 volts. In these scattered locations direct current has been superseded by alternating current. The downtown district, known as the Edison district, which covers an area of approximately 1.7 square miles, with a peak of 35,000 kw., is supplied by a number of substations equipped with either rotary converters or motor-generator sets. A number of developments have taken place in these substations so as to enable rotary converters to be started up under load. This territory is now being overlaid, and eventually alternating current will be available in any section of the territory served, including the present direct-current area.

The first waterside station was located at Twenty-sixth and Callowhill Streets, on the Schuylkill River, in 1898. Its major equipment consisted of four 1,000-kw., two-phase, 6,000-volt generators driven by horizontal compound condensing engines. In this station

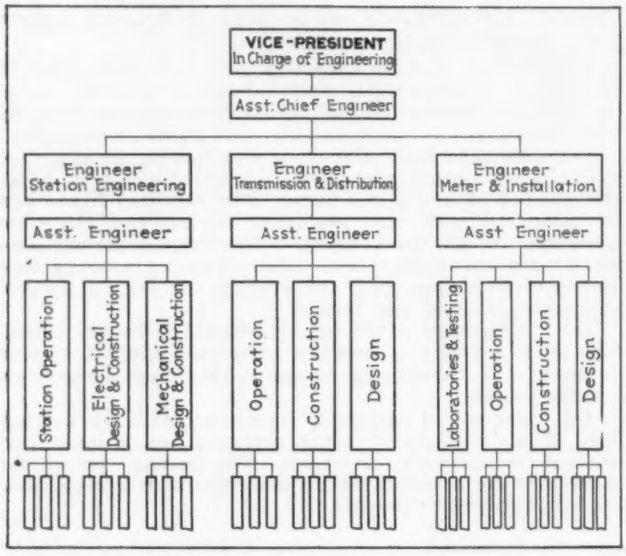


Fig. 1—Schematic Organization Chart of the Engineering Department of the Philadelphia Electric Company

the first complete equipment of oil switches was installed, and time-limit relays and instruments operated from transformers were first used here, so that all of the instruments and equipment on the switchboard were operated at low tension.

It was early appreciated that, in a city covering an area of 129 square miles with diversified industries in almost every section, many of which were power users, the transmission of necessity had to be at high voltage and suitable for power purposes. Polyphase alternating current had already been adopted, and the highest voltage at which underground cable could be operated commercially had to be used. At first this was 6,000 volts as generated, but later 13,200-volt, three-phase transmission to the substations was used and, by means of T-connected transformers at the substations, distributed at 2,300 volts, two-phase.

From the experience developed at Callowhill Street it was clearly shown that generating stations must be built of larger size and be capable of extensions to meet the growing load from year to year. Christian Street station, now known as Schuylkill Station No. 1, was designed to have all of the equipment on parallel lines; that is, each foot of extension would add to each of the essential elements—boiler capacity, engine room and switchboard space. At that time electrical manufacturers did not care to build generators for a higher voltage than 6,000, so that the original equipment in this plant consisted of engine-driven generators of this voltage. As later units were installed step-up transformers were used to raise the bus voltage to 13,200, at the same time changing to the three-phase form, which has remained the standard, although the later generators have been wound to give the voltage directly. The largest individual engine-driven set was 5,000 kw., driven by horizontal and vertical compound condensing Allis-Chalmers engines. These were later replaced by vertical Curtis turbo-generators, some of which are still in service.

The Philadelphia Electric Company has always believed in meeting all of the requirements for electrical energy of any character in the community in which it serves and has so designed and developed its system. When energy began to be supplied for street-railway service it became necessary for this company to furnish 25-cycle, 13,200-volt, three-phase energy to the substations of the railroad. At the beginning of this service this energy was furnished from frequency changers installed in the substation adjoining the Christian Street generating station. As this load grew turbo-alternators were installed to generate at this frequency.

With the electrification of the Paoli division of the Pennsylvania Railroad 25-cycle energy supply was again necessary, but in this case a single-phase supply

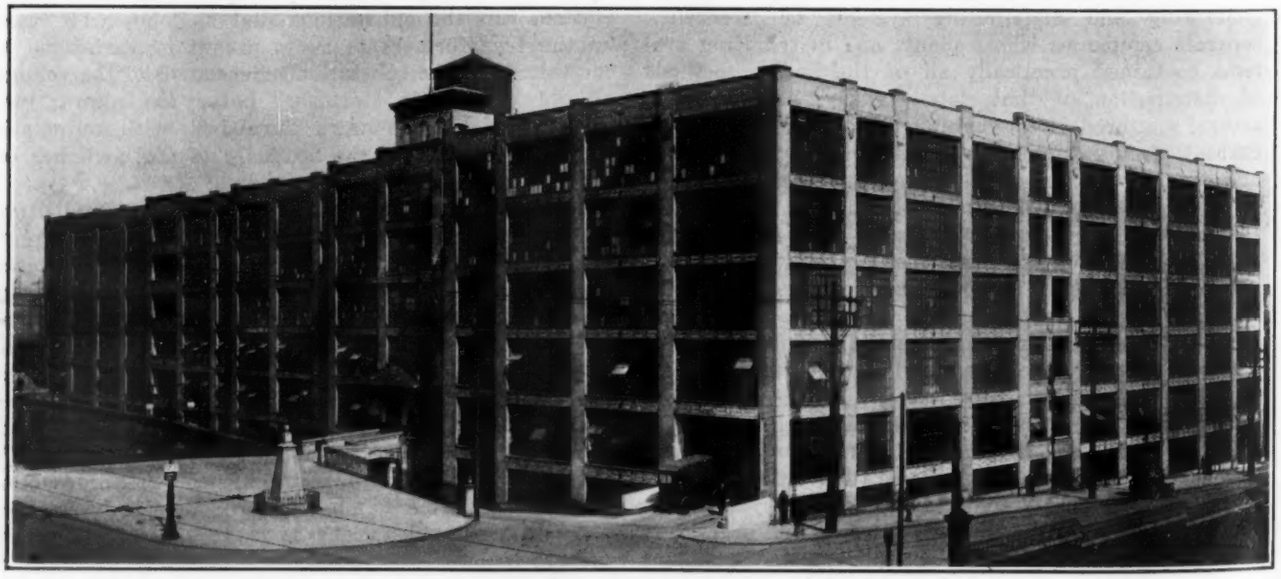


Fig. 2—The Central-Service Building Houses Many Activities

On the first floor are the receiving department, storage space for transformers and facilities for repairing and testing them, and storage space for cable reels, manhole castings, Edison tubes and other heavy material. The second floor provides garage space (the automobile repair shops being in another building closely adjacent) and loading platforms for the trucks used by the transmission and distribution department and the meter and installation department. The third floor is mainly devoted to the building offices, such as the mailing department, the doctor's office, etc., and the offices and drafting rooms of the transmission and distribution department. The fourth floor houses the offices of the station engineering department, the station electrical construction shops and storerooms, the meter and installation department shop and general machine, carpenter, paint and blacksmith shops. The meter and installation department offices, drafting rooms, laboratories, meter shop and meter storeroom, etc., use practically the entire fifth floor, while the sixth floor is occupied by the cost division, inventory bureau, electric shop stores, lamp stores and a cafeteria. This building has centralized many heretofore scattered departments.

was called for. This involved a number of complications, both in generation and in distribution, which were solved by the development of a phase balancer which distributed the single-phase load on the three phases of the generators. The solution of the problem was also assisted by the balancing of the load of the Chestnut Hill division, when it was electrified, against that of the other division, since these two single-phase loads were supplied from the individual phases of the loads, polyphase loads or direct current for traction loads may be supplied for individual consumers requiring this service and this load may be distributed uniformly on the 60-cycle generators supplying the system.

In the study of this transmission and distributing system in connection with the growth of the load the necessity was early recognized for distributing the generating stations. Fortunately, in the territory served

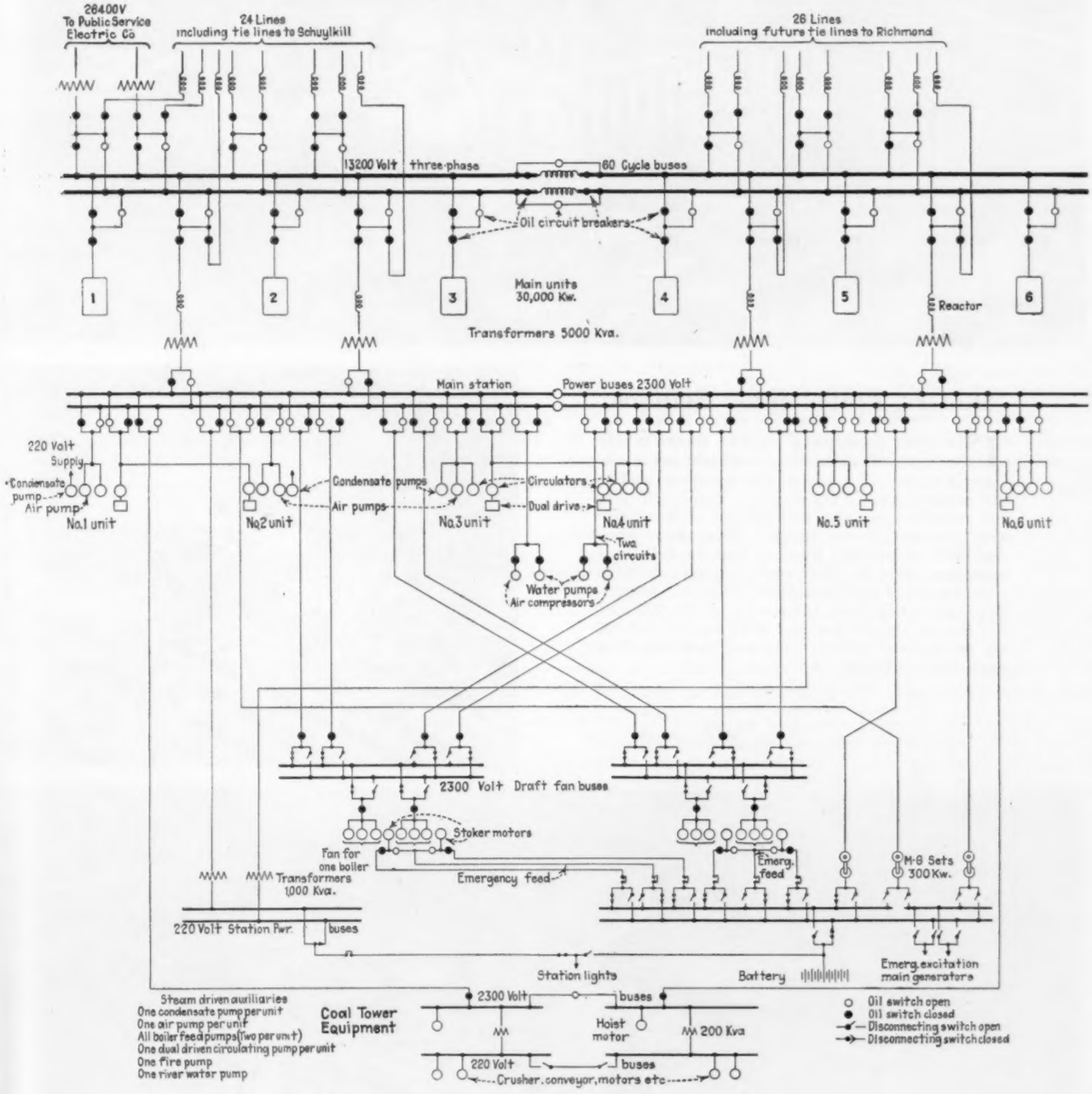


Fig. 4—One-Line Diagram of Delaware Station

two-phase system to which the railroad company transforms the energy.

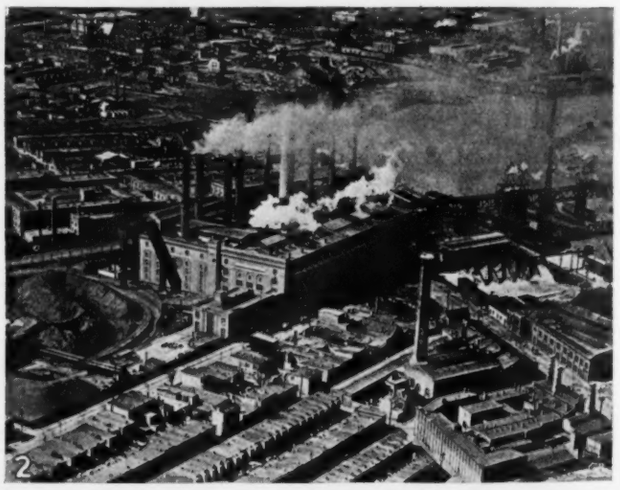
It has always been the policy of the Philadelphia Electric Company to maintain a uniform standard, and today all of its developments are being carried out at the 60-cycle frequency, traction, single-phase and 25-cycle loads being handled through substations using appropriate converting machinery, so that single-phase

there are two important rivers, the Delaware and the Schuylkill, which permitted the generating stations to be scattered around the territory. Generating stations are now installed at Chester, on the lower Delaware River; at Beach Street, on the upper Delaware River, and at Robbins Street, on the upper Delaware River. In addition, a new station is now under consideration at Lewis Street, on the upper Delaware River. There

Modern Philadelphia Stations

THE three generating stations shown typify the type of architecture which has made them a source of pride to the company and to the community. Ample space, highly efficient but reliable operation and ease of maintenance are features of the design. They have been designed on parallel lines in that each foot of extension adds to boiler room capacity, turbine room capacity and switchhouse space. Schuylkill station will have a capacity of 150,000 kw., Chester of 120,000 kw. and Delaware of 180,000 kw. at the end of this year and now supply a peak load of 300,000 kw.

No. 1. Delaware station.
No. 2. Schuylkill station.
No. 3. Chester Station.



has also been an addition to the Schuylkill station, known as Schuylkill No. 2, on the Schuylkill River.

The engineering department of the Philadelphia Electric Company has charge of all phases of the engineering work of the company, including design, construction and operation. To this end the chief engineer is one of the vice-presidents. The engineering organization is divided into three branches, as shown on the accompanying chart (Fig. 1), the head of each branch being known as the engineer of that branch.

TABLE I—GROWTH OF THE PHILADELPHIA ELECTRIC COMPANY IN TEN YEARS

	1914	1924
Generating capacity, kw.	112,786	387,480
Peak load of previous year, kw.	82,000	299,438
Kw.-hr. generated in previous year	253,000,000	1,148,000,000
Yearly load factor (referred to annual peak), per cent.	35.	43.7
Daily load factor (referred to daily peak), per cent.	.....	60 to 75
Connected load (general light and power), kw.	150,000	626,000
Connected load (railway load), kw.	27,000	75,450
Meters in service	62,000	316,000
Company employees	2,500	5,500

These branches are the station engineering department, which has charge of generating and substations; the transmission and distribution department, which has charge of the conductor system, including street lighting, and the meter and installation department, which has charge of all work on customers' premises and includes the laboratory, which does all testing work. Each of these departments is, broadly speaking, divided into design, construction and operation divisions.

The general engineering offices, the design division of the station engineering department and the load dispatcher's office are in the general office building, at Tenth and Chestnut Streets, and the rest of the engineering department has headquarters in the central service building, which is located at Twenty-third and Market Streets, Philadelphia.

This building, which is shown in Fig. 2, is a centrally located reinforced-concrete, six-story building, having an area of 61,000 sq.ft., or about 1.4 acres per floor. It faces on two streets and has a railroad siding with an unloading platform. The relation of the street level to the two lower floors is such that automobiles may enter both of these floors, and in addition to the usual elevator equipment, there are two freight elevators capable of carrying loaded automobiles to any floor. This building houses a large variety of company activities, which formerly were spread around in numerous smaller buildings all over the city. By assembling all of them in one large building a great deal of time has been saved. In general, all of the branches of the engineering department which are not housed in the general office building or in the generating stations or substations are located here.

The general character of the territory served, the methods of transmission and distribution and the sources and methods of power supply have been touched upon in the article by J. B. McCall, president of the company, in this issue and in the earlier part of this article. The details of the methods of generation, of distribution and of providing service to customers are described in the section that follows, together with an outline of the activities of the respective departments of the engineering division.

Part II — The Station Engineering Department and Its Activities

THIS department is responsible for the design, construction and operation of the generating stations and substations, and an account of the methods and problems of energy production in the Philadelphia district will show its method of functioning.

The demand for electrical energy in metropolitan Philadelphia, which includes the city of Chester, about 14 miles distant, and the large manufacturing districts along the Delaware River, in 1923 reached a peak of approximately 300,000 kw. This is supplied by the Philadelphia Electric Company system from three main generating stations, Schuylkill, Chester and Delaware, airplane views of which are shown in accompanying illustrations.

Schuylkill station, situated on the river of the same name, precedes the others in point of age. In 1916 it reached its maximum development of 150,000 kw., consisting now of three horizontal units of 35,000, 30,000 and 20,000 kw. capacity and five older vertical units.

Chester station, on the Delaware River in the lower part of the city of Chester, was placed in service in 1918, and at the end of this year will reach its ultimate development of 120,000 kw. in four 30,000-kw. units. This station is about 14 miles southwest of Schuylkill station and is connected to it by means of duplicate 66,000-volt transmission lines totaling 75,000 kva. capacity.

Delaware station, which is on the Delaware River in the Kensington industrial district, was built in 1920. At the end of this year it will reach its ultimate development of 180,000 kw. in six 30,000-kw. units. Situated about 3¾ miles northeast of the Schuylkill plant, it is tied to this station by four 13,200-volt tie lines totaling 24,000 kva. capacity.

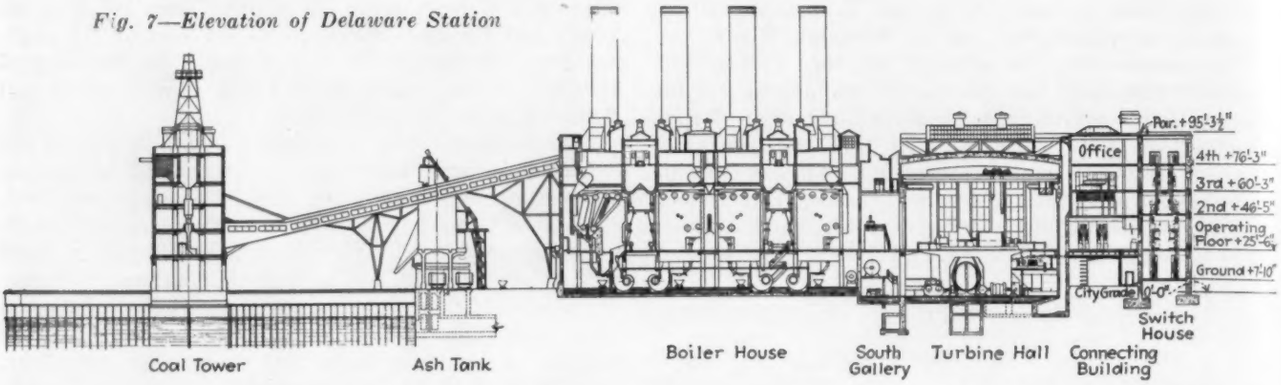
In addition to the above three main generating plants, there is the smaller Tacony station, of about 18,000 kw. capacity, on the Delaware River about 5 miles above Delaware station. Very little energy is generated at this point, though one unit is operated a considerable portion of the time mainly to supply reactive kva. and maintain better voltage conditions in the vicinity of this station.

Generation at Delaware and Chester stations is entirely at 60 cycles, while the Schuylkill plant supplies both 60 cycles and 25 cycles. All of the generators, except some of the older ones, are rated at 13,200 volts, three-phase. The greater proportion of the energy is transmitted at this voltage, using 350,000-circ.mil cables which are rated at 6,000 kva. each.

All three generating stations are laid out along somewhat similar lines with the exception of the older section of the Schuylkill station, which spans a considerable period of development. A brief description of Delaware station will be fairly indicative of Chester station and to a certain extent of the older Schuylkill station.

A detailed description of the mechanical features of the first half of Delaware station was published in the ELECTRICAL WORLD for May 21, 1921, page 1145. The same general details were followed out in the design of the last half of the plant except that the economizer

Fig. 7—Elevation of Delaware Station



surface was made larger and better light and ventilation were obtained in the boiler-room design. Since that article was published de-aërators have been installed throughout the plant and evaporators have been added. All of the make-up water is now distilled.

There are at present in operation five 30,000-kw. General Electric single-barrel turbines, and one 30,000-kw. Westinghouse turbine is being installed. These turbines are all equipped with 50,000-sq.ft. surface condensers and duplicate auxiliaries. In all cases there is one steam and one electric auxiliary provided, principally for the purpose of reliability. Fig. 7 shows a cross-section elevation of the Delaware station.

FEATURES OF THE BOILER ROOM

In the boiler rooms there are twenty-four Stirling boilers aggregating 35,000 hp., twelve of which are constructed with integral economizers having 25 per cent heating surface. The other twelve boilers are furnished with two drum economizers having 50 per cent of the boiler heating surface. All of the boiler auxiliaries are driven by variable-speed alternating-current motors with the exception of the stokers, which are operated through direct-current motors.

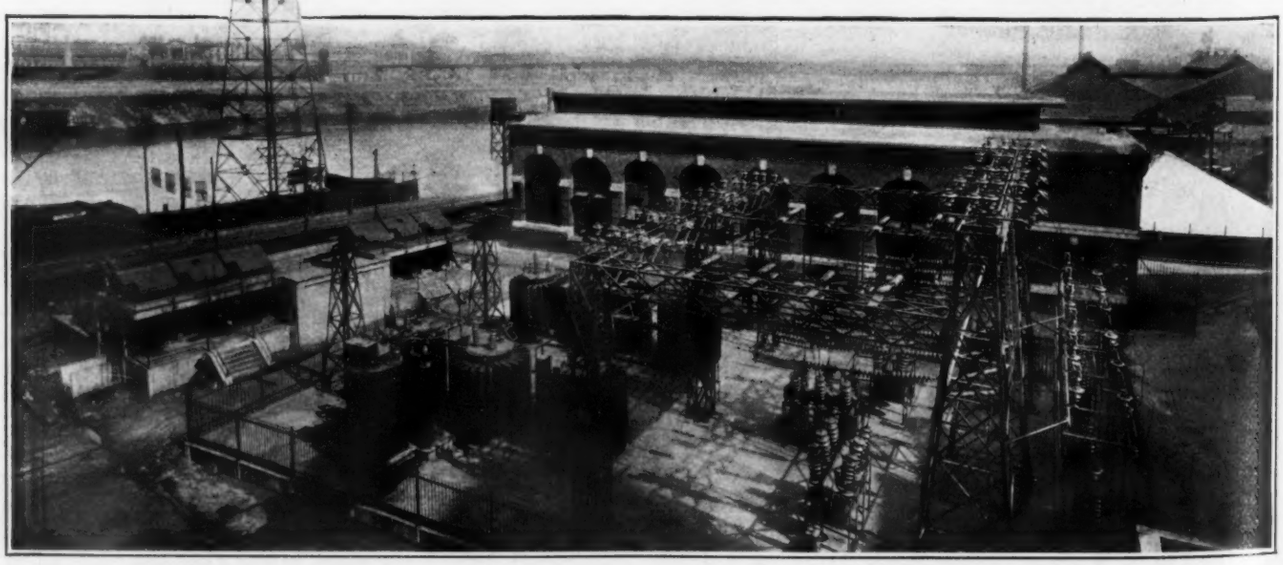
The coal for this plant is all brought in by barge from a near-by coal terminal or from a coal-storage yard, which will be described later. There is no permanent coal reserve at the plant other than a very small supply in overhead bunkers. In order, however, to insure a continuous supply of coal three or four coal barges, each carrying about 1,000 tons, are always available at the plant. The coal is carried into the plant by means of duplicate coal hoisting towers, where the coal after being raised is passed over picking tables, magnetic separators and crushers and then passes by means of belt conveyors to the bunkers in the boiler room.

Ash disposal at this plant is by means of small industrial cars and storage-battery locomotives to skip hoists, where the ash is raised to a tank outside the building situated so that ashes can be discharged at will into either a barge, railroad cars or trucks.

The generators are rated at 30,000 kw., the last unit at 80 per cent and the other five at 90 per cent power factor. They are equipped with shaft end exciters and balanced relay protection, and are arranged for extinguishing internal fires by means of water.

Fig. 4 shows a single line diagram of Delaware station, on which it is to be noted that each generator can be connected through a main and two selector oil circuit breakers to either of two buses. Although only one bus is operated at a time, both are considered main

Fig. 8—Step-up and Regulating Station at Schuylkill



buses and are used interchangeably. Outgoing lines are in groups, the selector switches connecting the operating bus to a stub bus from which two outgoing lines are extended. The more important high-capacity outgoing lines are treated as generators and have no other equipment paired with them. All of the outgoing lines and station light and power transformers are equipped with current-limiting reactors. These are, in general, rated at 3 per cent, 6,800 kva., though in the case of tie lines to Schuylkill 1½ per cent reactors are used, and in certain special cases 6 per cent.

The non-automatic selector oil circuit breakers are Westinghouse type CO-11 and CO-22, and the automatic main oil circuit breakers General Electric H-206 and H-209, the larger breakers in both cases being on the generators.

The main 13,200-volt buses are sectionalized in the middle with reactors rated at 5 per cent of the capacity of one generator, or 33,333 kva. These reactors can be short-circuited by an oil switch when the load conditions are such that they can be taken out of service.

The large majority of the auxiliaries are electrically driven. The supply to the motors is through transformers connected to the main busbars and stepping down to 2,400 volts, three-phase. All motors of approximately 100 hp. and above are wound for this voltage, but for the supply of small motors and lighting T-connected transformers stepping down to 240-volt, two-phase, five-wire, are provided. The stoker motors

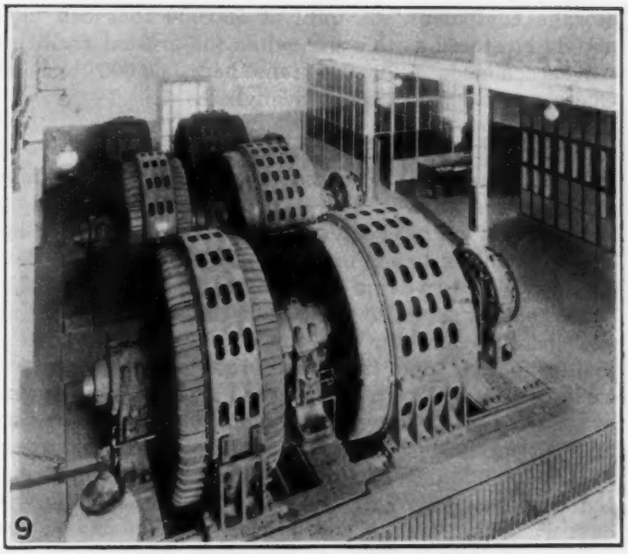
Figs. 9 and 10—Interior and Exterior Views of Somerset Substation
Figs. 11 and 12—Exterior and Interior Views of Race Substation

and cranes are wound for 250 volts direct current and are supplied from three motor-generator sets and a standby storage battery. This direct-current system is also arranged to supply emergency excitation in the event of failure of the shaft end exciter, though under these conditions the excitation will be isolated from the rest of the direct-current service. All of the important alternating-current auxiliary motors are differentially protected and arranged upon interruption of service to come back immediately to their original condition of operation upon re-establishment of voltage. Where variable speed is required slip-ring motors are installed.

Two features that may be of interest are the use of reactors for starting air and condensate pump motors and the use of synchronous motors with full voltage starting on the duplex circulating pumps. These latter are arranged to operate at leading power factor and thus offset the low power factor of the rest of the auxiliary system.

In the operating room are controlled not only the generators and outgoing lines, but also the station auxiliary substation. A pipe room below facilitates the secondary and control connections. An 800-kva. testing transformer with induction regulator is provided.

There is space for the storage of coal at both Schuylkill and Chester, but, as noted above, at Delaware no storage other than the bunkers and coal barges moored to the wharf can be made. To take care of Delaware station in this regard and provide a general coal reserve for the entire system, 45 acres of ground on Petty's Island, in the Delaware River, was acquired, and this has been equipped with coal unloading and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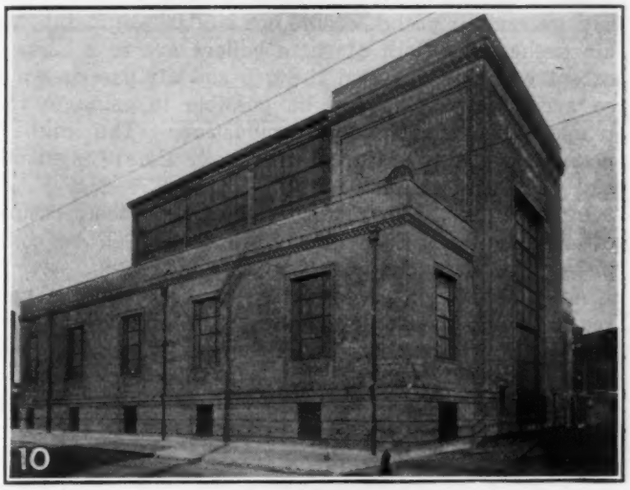
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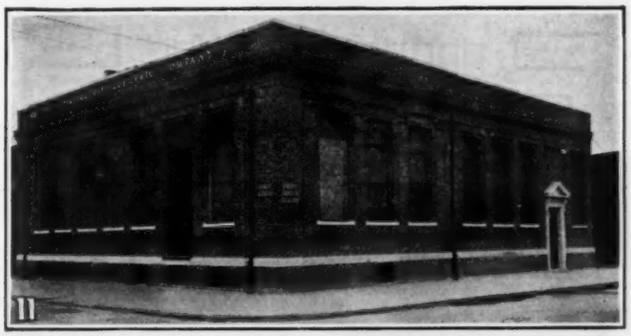
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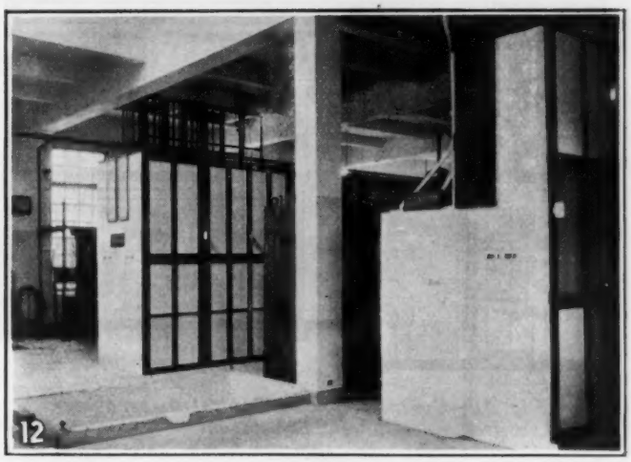
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storage equipment. A total of 500,000 tons can ultimately be stored at this site, while the present facilities will accommodate 200,000 tons here, 60,000 tons at Chester and 40,000 tons at Schuylkill.

Air Preheaters Used in Chester Station

In the mechanical design of this year's additions to Chester station a new feature has been added in the shape of air preheaters. There are eight 1,422-hp. Stirling boilers being installed, six of which are constructed with two-drum economizers having about 5,250 sq.ft. heating surface. On two of these there are being installed two different designs of plate air preheaters and on four of them there are to be tubular preheaters, each of 22,000 sq.ft. heating surface. The temperature of the air for combustion where economizers and air preheaters are used will reach a maximum of about 325 deg. F. at 330 per cent rating, and the corresponding exit gas temperatures will be 410 deg. F. Two other boilers without economizers are being installed, one of which will have a 65,000-sq.ft. Ljungstrom air preheater and one a 50,000-sq.ft. tubular air preheater. Both of these boilers are to a certain extent experimental, and the gas and air passages are so arranged that it will be possible to regulate the temperature of air for combustion. The highest possible air temperatures with both the Ljungstrom and the large tubular heater will be 650 deg. F. at 350 per cent of boiler rating, with exit gas temperature of 410 deg. F. These installations will all be completed and placed in operation this year.

As all three of our main generating stations will reach their ultimate development with this year's construction, property on the Delaware River 2¾ miles above Delaware station has been bought, and a design is now under way for the erection of a new plant to be known as "Richmond station." It is divided into two main parts, one for the storage of coal and the other for the station itself. The station is designed for twelve 50,000-kw. units, of which one is spare, or an output of 550,000 kw. In reality it will be three separate 200,000-kw. plants, since boiler house, turbine room and switch house will be divided into three separate buildings, though steam and electrical interconnections may be arranged for. Each will be provided with its own operating room and station auxiliary supply. The bulk of the transmission, at least for the present, will continue at 13,200 volts, but arrangements are being made for transformer banks to step up to 66,000 volts for transmission by underground, single-conductor cables to the various load centers.

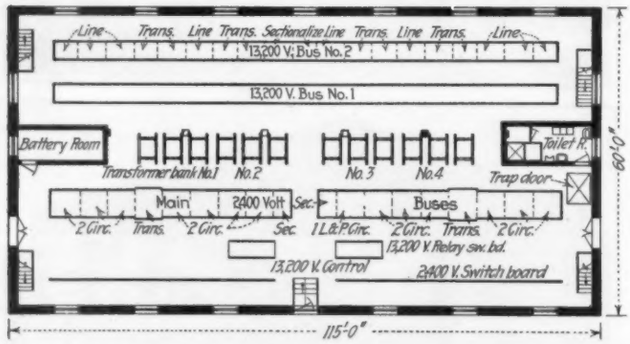


Fig. 13—Plan of Typical Alternating-Current Substation

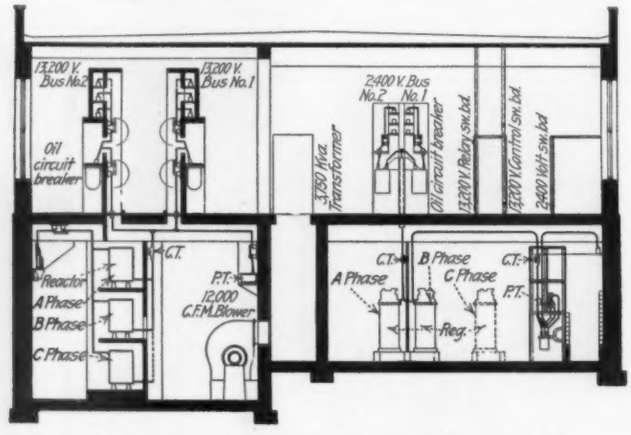


Fig. 14—Cross-Section of Typical Alternating-Current Substation

The alternating-current substations are laid out with duplicate 13,200-volt buses and a sufficient number of sections to control the incoming transmission lines and the outgoing distribution lines. It is desirable to have current-limiting reactors on the outgoing lines in order to lessen the duty on the oil circuit breakers installed in industrial substations, on customers' premises and on the fuses which protect 13,200-volt transformer banks. Since the number and location on the bus of the 13,200-volt distribution circuits cannot be definitely predetermined, it has been the policy to design the substation so that reactors can be installed on any of these sections.

As mentioned before, the Chester and Schuylkill plants are tied together with duplicate 66,000-volt transmission lines. Fig. 8 shows the outdoor installation at Schuylkill, where the voltage is stepped up by two 18,750-kva. transformer banks and the voltage and power factor are regulated by means of a 1,750-kva., 13,600-volt, three-phase induction regulator on each bank. These regulators were installed in 1920 and are still the largest of their kind ever built. This year an interesting installation of tap-changing transformers is to be made at the Chester end of this line, four 20,000-kva., three-phase transformer banks being installed.

Also of interest is Somerset substation, which was erected to house frequency changers supplying 25-cycle energy to the West Jersey & Seashore Railroad of the Pennsylvania Railroad system. The substation is laid out for four 6,000-kw. sets, of which three have been installed. While the present supply is balanced three-phase, the electrification using a direct-current supply from rotary converters, it is ultimately planned to change to 11,000 volts, single-phase. The energy is stepped up by the railroad company to 35,000 volts (ultimately 44,000 volts) in an adjacent outdoor substation for transmission to its own substations.

Principles of Substation Design

Duplicate 2,400-volt busbars are also provided and supplied through T-connected air-blast transformer banks. Banks of 5,000 kva. and 7,500 kva. have been standardized, most of the installations being of the latter. Each transformer is of 2,500-kva. or 3,750-kva. capacity and can be used either as a main or a teaser. The secondary side is wound for 2,540 volts with four 2½ per cent taps. Distribution sections rated at 2,400 volts are provided mainly with 200-amp. induction regulators, though there are also a number of 150-amp.

rating in service. Space is available for regulators of larger capacity, though none have been ordered for these stations.

In all of the newer substations provision has been made for changing to 4,000/2,300 volt, four-wire, three-phase distribution, room having been left for the installation of a third transformer in each bank and a third regulator on each circuit. Automatic circuit reclosing of distribution circuits is installed on one substation and will probably be extended to others in the future.

Figs. 11 and 12 show exterior and interior views of one of the latest substations—Race—the interior view having been taken before all the details were completed. Figs. 13, 14 and 15 show plan, cross-section and single-line diagrams, respectively, of a typical alternating-current substation.

In order to take care of the increased growth of the system, four new substations and extensive additions to three others are being erected. Additional converting and transforming equipment is being installed in many more.

There are at present about fifty 13,200-volt industrial customers requiring in some cases as much as 5,000 kva. capacity. For these industrial customer installations oil circuit breakers of about 5,000-amp. rupturing capacity are used. It is planned to try out truck-type equipment for such installations in the near future.

Properly to correlate the operation of the entire system, the load dispatcher's office is at the main building, Tenth and Chestnut Streets. Telephone connections to all the stations and some of the industrial customers are provided, and there is a board indicating the system layout. Small lights indicate the position of the oil circuit breakers, their operation being from small buttons at the load dispatcher's elbow. Load indications are automatically transmitted from the generating stations, and an instrument totals this to give the system total. (This scheme is described in the ELECTRICAL WORLD for Aug. 16, 1919, and Oct. 25, 1919.)

Part III—The Transmission and Distribution Department and Its Work

THIS department is charged with the design, construction and maintenance of the conductor systems both between generating stations and substations and between substations and customers, and includes transformers and street lights. Its activities are limited by station walls and customers' premises and it has no share in substation operation.

The transmission system consists mainly of 13,200-

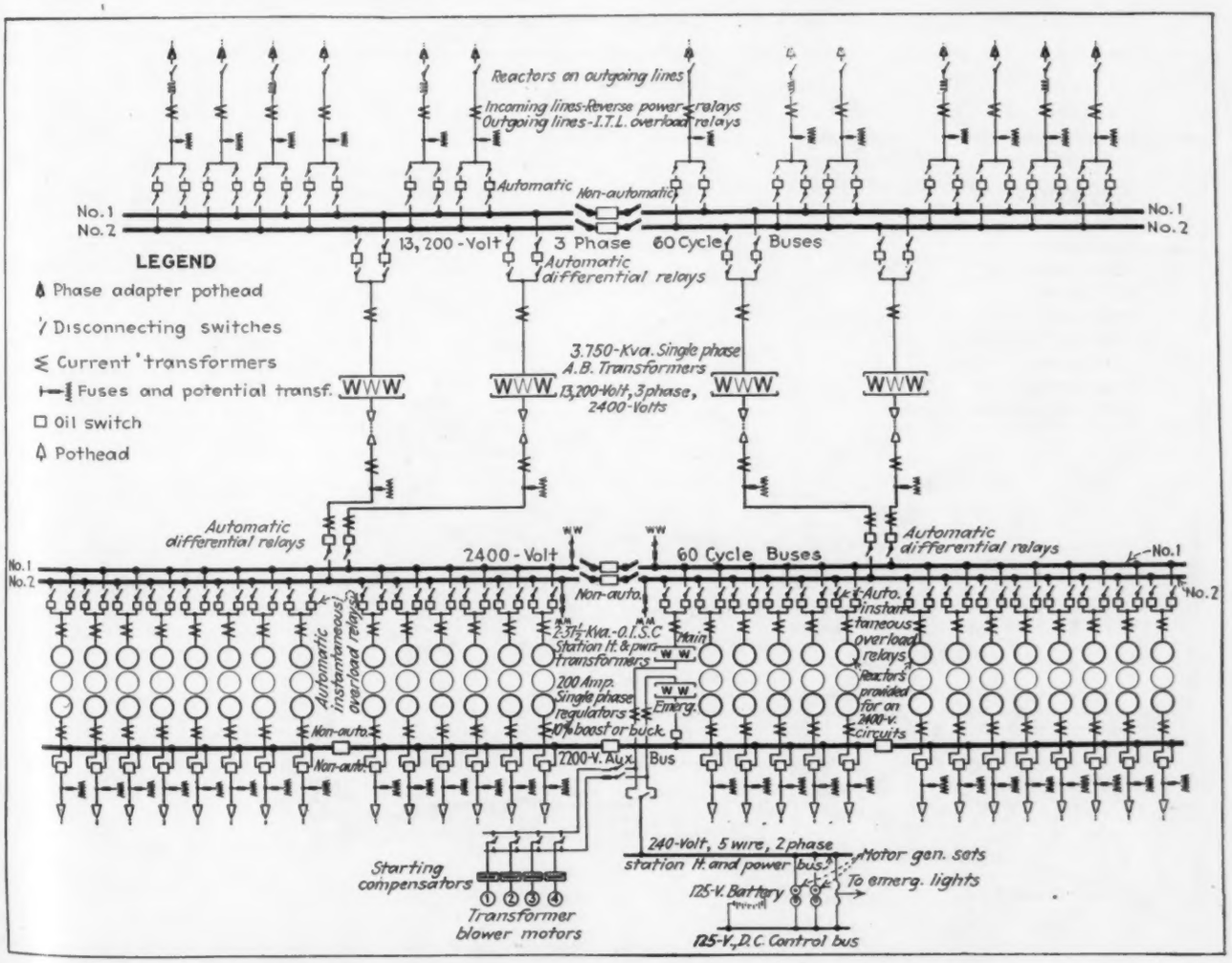


Fig. 15—Single-Line Diagram of Typical Alternating-Current Substation

volt lines, principally underground, owing to the preponderatingly urban character of the territory served, and approximately 14 miles of two-circuit, 66,000-volt steel-tower line construction tying together the Schuylkill and Chester generating stations. There is still remaining a small amount of 6,000-volt, 60-cycle transmission, principally underground, which is being rapidly replaced by 13,200-volt cable.

There is a relatively small amount of underground 25-cycle transmission for service to the Pennsylvania Railroad Company and the Philadelphia Rapid Transit Company.

The map (Fig. 16) shows schematically the 60-cycle transmission system and also includes a number of the 13,200-volt industrial distribution lines. It will be noted that the layout of the transmission system is in general radial. The map is not to scale.

Distribution System

The general primary distribution system is 2,300 volts, two-phase, three-wire, principally aërial. There is a total of 229 2,300-volt circuits. General secondary distribution is 115/230 volts, single-phase, three-wire, for lighting and 115/230 volts, two-phase, five-wire, for power. There are 7,600 2,300-volt primary distribution transformers, totaling 221,000 kva.

A number of years ago a trial was made of 13,200 volts for aërial primary distribution, and this voltage has been utilized to a large degree during the past two years for rendering service to medium and large industrial power customers, regardless of the service voltage, utilizing transformers where necessary, instead of by means of 2,300-volt feeders from substations. The 13,200-volt distribution system has been utilized also for relief of heavy loads from 2,300-volt feeders and has resulted in marked distribution economies and increased flexibility in rendering service. There are 220 13,200-volt primary distribution transformers, totaling 42,600 kva.

Street-lighting distribution is effected by series circuits supplied mainly from Brush arc machines and mercury-arc rectifiers. The introduction and extensive use of series incandescent street lighting has resulted in the use of some pole and subway type constant-current transformers supplied from the 2,300-volt distribution system instead of constant-current transformers in substations.

Underground Transmission at 13,200 Volts

There are approximately 326 miles of 13,200-volt underground transmission cable, which largely consists of 3 × 350,000-circ.mil sector-type paper-lead cable, insulated with $\frac{6}{32}$- x $\frac{7}{32}$-in. impregnated paper. The nominal rating of this size of cable is 6,000 kva. A smaller portion of transmission cable mileage is in 3 × 250,000-circ.mil cable.

Conduit for transmission cable is 4-in., either single terra-cotta duct or fiber duct. Conduit runs for transmission purposes have been restricted to not over twelve ducts per run, except under unusual conditions, in order to avoid derating the cables below an economical value.

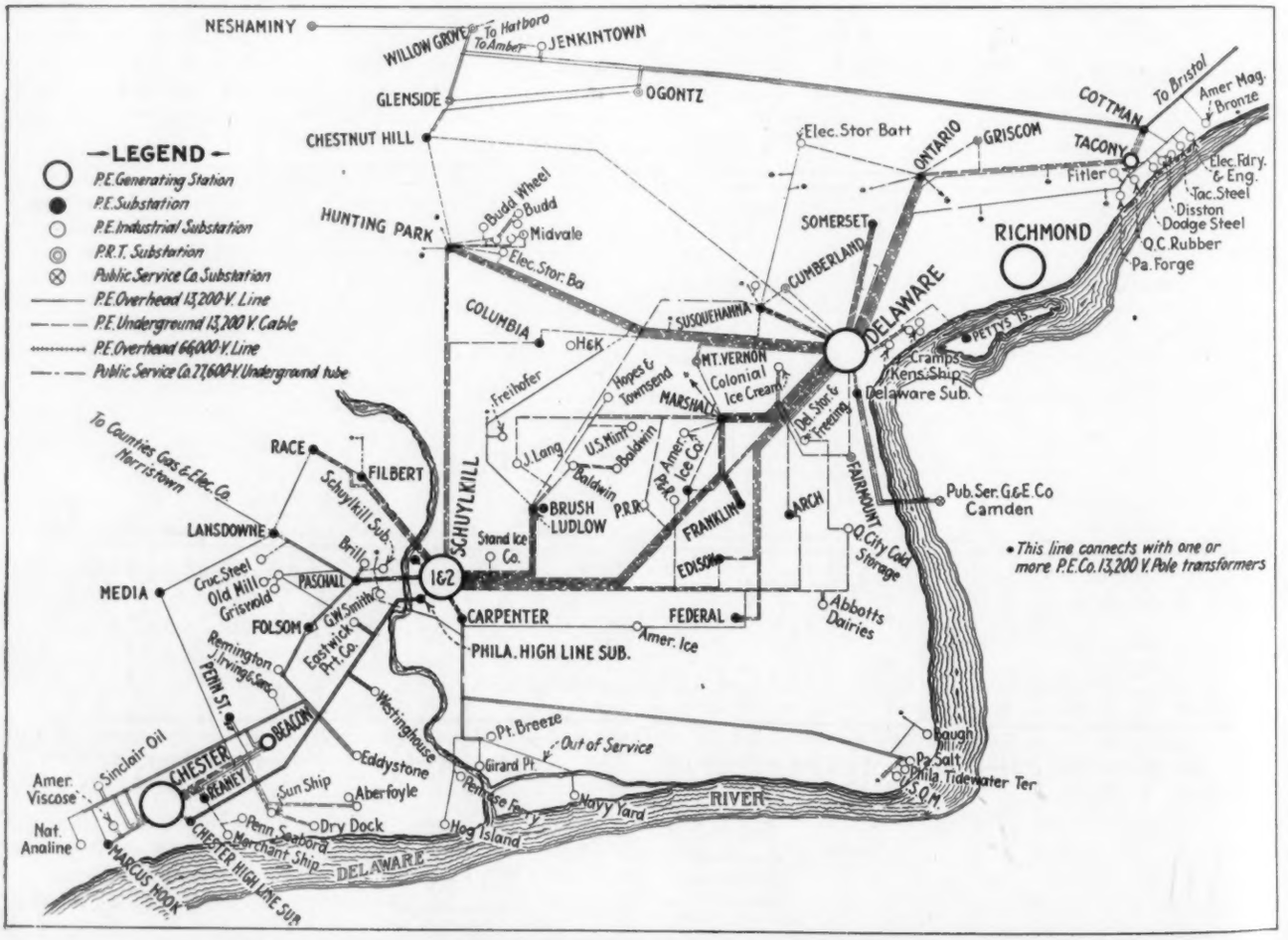
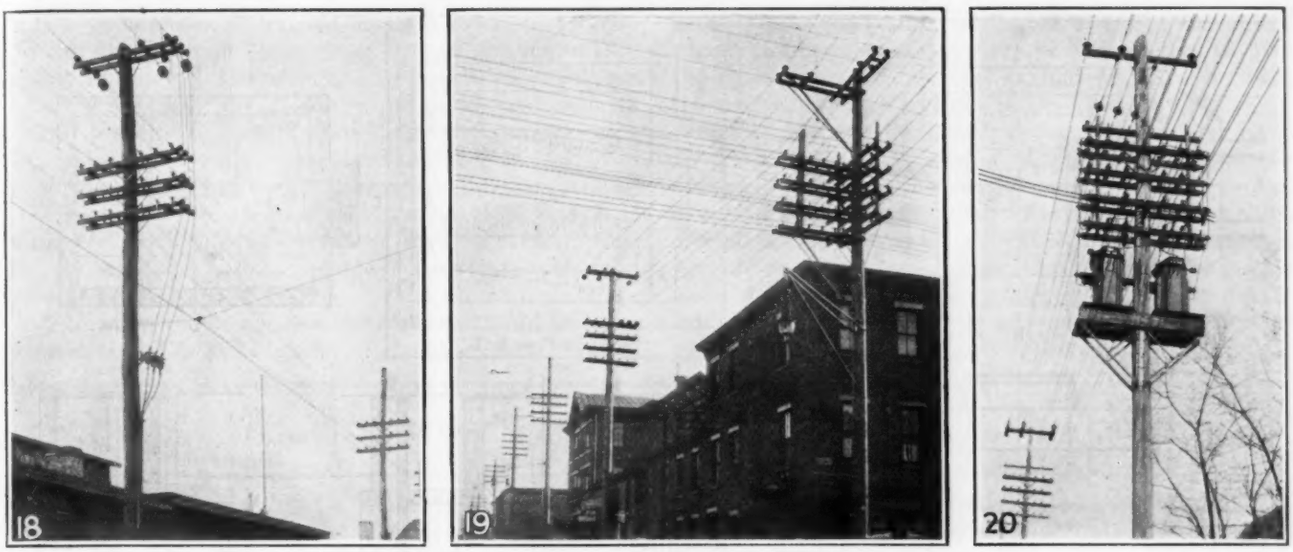


Fig. 16—Schematic Layout of 60-Cycle Transmission System and a Number of 13,200-Volt Distribution Lines



Figs. 18, 19 and 20—Typical Aërial Construction of the Philadelphia System

Transmission at 66,000 volts is used to tie in Schuylkill station in Philadelphia with Chester station of the Delaware County Electric Company (a subsidiary company) in Chester. In addition, two comparatively large customers, the Westinghouse Electric & Manufacturing Company and the Philadelphia Rapid Transit Company, have 66,000-volt substations which are tapped to this line. The transmission line consists of six No. 2/0 hard-drawn copper cables and two ⅜-in. copper-clad ground wires supported on double-circuit steel towers. The transmission line is insulated for 110,000 volts with eight insulators in suspension strings and nine insulators in strain strings.

The Philadelphia Electric system has recently been connected with the Public Service Electric Company of New Jersey system by means of three three-conductor, 350,000-circ.mil, 26,400-volt cables. These cables run from an outdoor substation containing two 12,000-kva. transformer tanks and located near Delaware station in underground and submarine cable to the Atlantic Avenue substation (Camden) of the Public Service Company of New Jersey.

Special precautions were taken with the submarine crossing, which is about 400 ft. up from the new Delaware River Bridge location. A trench was dredged across the channel to a depth of 5 ft. below the projected 35-ft. channel, the present channel depth being 30 ft. The three cables were laid in the trench on 5-ft. centers from a barge attached to a dredge which was worked across the river directly over the trench. The proper spacing and location of the cable were checked by a diver during the laying.

AËRIAL SYSTEM ON WOOD POLES

The aërial system is constructed very largely with chestnut poles, although within the last year Western red cedar poles have been used for heavy work. The chestnut poles are untreated, but all cedar poles are purchased "butt-treated." One-half-inch penetration of the creosote oil is required. There are in all 88,000 poles on the system.

A special feature is the elimination of buck-arm construction at corners by the use of extension arms. This permits setting the poles approximately on the house line, results in clearer climbing space and avoids taps at a considerable distance from the pole. The extension arms are braced by means of a special angle-iron brace extending from the end of the lower arm to the pole. The upper arms are braced by vertical pieces of timber bolted between the cross-arms. This same method of supporting the upper arms has been largely used throughout the system.

Connection between underground and aërial lines is made at terminal poles by supporting the potheads on a bracket not less than 4 ft. below the lowest cross-arm and carrying the conductors down over the ends of the cross-arms on brackets or insulators from the line cross-arm. For 13,200-volt construction single-conductor potheads are used and single cable to the first manhole.

Transformers are carried on platforms except for 37½-kva. and smaller sizes, which are generally hung on the arms. Standardized braces and fittings are used for transformer platform construction. Figs. 18, 19 and 20 show typical aërial line construction work as installed on the system.

The standard wire sizes are Nos. 6, 4, 2 and 2/0 solid triple braid, weatherproof. No. 8 line is used for arc circuits and short two-wire service loops.

Transformers in the 2,300-volt class are protected by oil fuse cut-outs for sizes 75 kva. and above, by expulsion fuses for sizes 15 kva. to 50 kva. and by porcelain cutouts below 15 kva. Transformers in the 13,200-volt class are protected by 100-amp. and 150-amp., 25,000-volt "S&C" fuses carried in combination fuse and disconnecting-switch mountings.

Protection of 2,300-volt transformers has been afforded by arresters through the outlying sections, but complete protection in the closely built-up sections has not been necessary. Transformers 37½ kva. and larger are being equipped with "motometer"-type maximum-hand indicating thermometers in order to operate on a temperature basis and to indicate the necessity for load tests.

For aërial street-lighting suspension a three-pipe mast arm in 10-ft. and 15-ft. lengths has been used. This construction, shown in Fig. 19, results in low maintenance and depreciation, simple and rigid construction and no obstruction of the pole space above the horizontal pipe.

The underground system includes the larger portion

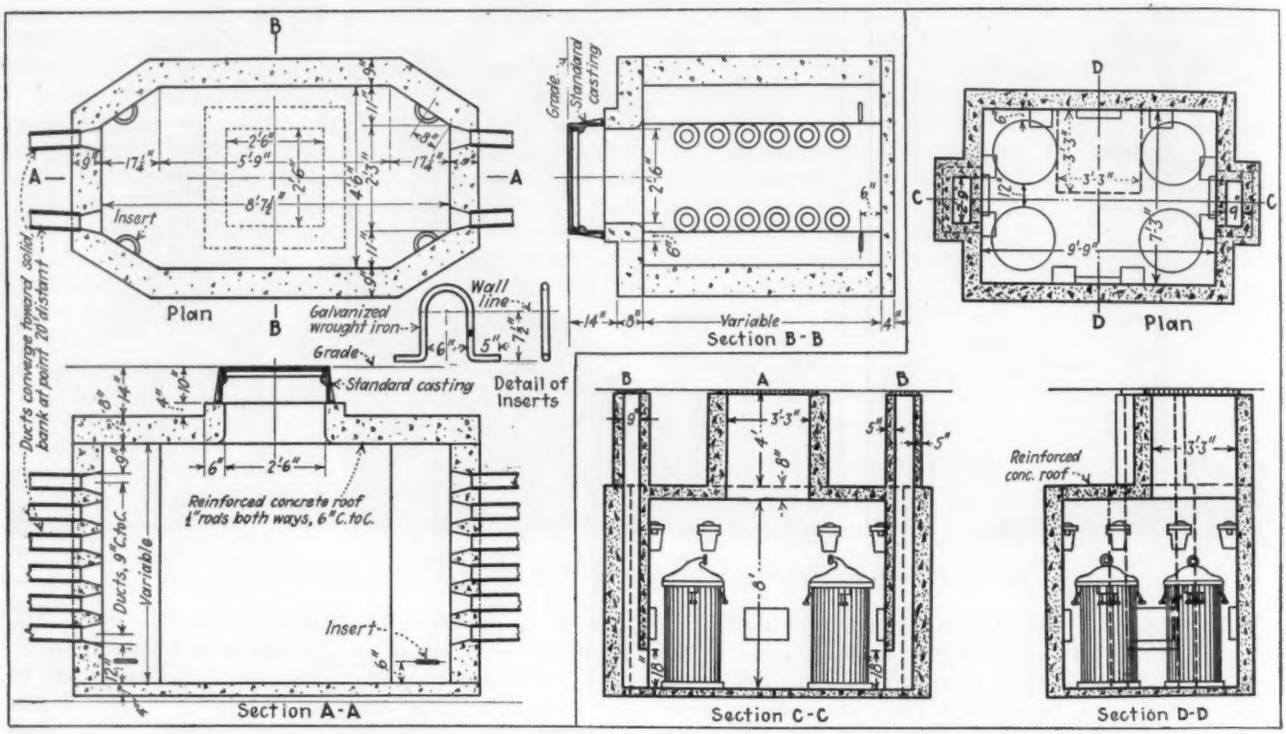


Fig. 21—Typical Cable Manhole Design.

Fig. 22—Typical Transformer Manhole Design

of the transmission and a portion of the distribution in the city of Philadelphia.

Extensive use is made of the duct system of the Keystone Telephone Company on a rental basis. Both single terra-cotta and fiber duct are used, 4-in. for 13,200-volt cables and 3-in. for other purposes. There are 14,680,000 duct feet of conduit and 7,200 manholes on the system.

Especial attention has been given to making cable manholes of adequate size and proper design for clean dressing of cables with minimum bending and for ease of splicing. Fig. 21 shows a typical design. All cables, except for series street lighting, are fireproofed with cement to a thickness of ½ in., a protection which has proved its value in many cases.

The introduction of alternating current in the Edison district has made necessary the adoption of new standards for transformer manholes, on account of the magnitude of the loads and the practical impossibility of locating manholes in the roadway. Recourse has been had to several types to meet various conditions, and in many cases provisions have been made for natural ventilation, utilizing the "chimney" effect as in a pipeless heater, with the openings covered with suitable gratings. A typical design of this ventilating system is shown in Fig. 22.

Concrete manholes have been standardized to facilitate economy and rapidity of construction, and removable forms are utilized. Frequently two hours after excavation has been completed forms have been placed and walls have been poured. This is accomplished by the use of ready-mixed concrete from a central mixing plant.

On the 2,300-volt system, three-conductor, 250,000-circ.mil paper-lead cable is utilized for feeders and 115,000-circ.mil for smaller branches. Insulation is $\frac{4}{32}$ in. x $\frac{5}{32}$ in.

On the 115/230-volt underground system three-conductor, 500,000-circ.mil, 350,000-circ.mil and 160,000-circ.mil cables are used for both alternating-current and direct-current mains. The alternating-current 115/230-volt mains are radial, but the direct-current mains compose a network.

The direct-current system comprises 245,000 ft. of three-conductor mains, of which about 50 per cent consists of Edison tube and the remainder of cable, principally 3 × 500,000 circ.mil and 3 × 350,000 circ.mil. Feeders are 1,000,000-circ.mil, single-conductor paper-lead, except near the substations, where 1,500,000-circ.mil cable is utilized to reduce heating. At practically every street intersection the mains are brought into street junction boxes and the feeders are brought into these boxes. Feeders are fused at the substation and junction box, and the mains are also fused.

The total connected load on the direct-current system is 80,500 kw., of which approximately 45 per cent is in lighting. There are 215 feeders from the five direct-current substations, of which seventy are direct to customers and the rest run to junction boxes. Loads over 100 kw. in general are supplied by direct feeders.

A system of special manholes has been devised for bringing out transmission cables from the newer generating stations which results in complete flexibility and maximum insurance to service. This method is shown by Figs. 23 and 24.

Marked economies have been attained in the installation of park lighting cable by the use of a deep-soil plow, to which the cable is attached and which is pulled by a portable gasoline engine. The cable is plowed in to an 18-in. depth. Approximately 54 miles of cable have been installed in this manner.

STREET LIGHTING OF SEVERAL TYPES

At present there are about 14,000 9.6-cp. series-arc lamps, 4,400 5-amp. luminous or magnetite arc lamps and about 2,500 9.6-amp. and 5.5-amp., 1,000-cp., 250-cp. and 100-cp. series incandescent lamps in the city. The

1,000-cp. lamps are installed on twin ornamental lamp standards on Broad Street from Oregon Avenue to City Line, the 600-cp. lamps on the Roosevelt and Southern Boulevards, the 250-cp. lamps in parks and squares about the city, and the 100-cp. lamps on country roads in the extreme outlying sections of the city.

About 30 per cent of the city arc lighting will be changed to series incandescent during 1924, and it is expected that the entire street-lighting system will be changed to series incandescent, within the next few years.

The fixtures for the new incandescent lighting were designed by the Philadelphia Electric Company and will be equipped with light alabaster ripple-glass globes, this type of globe having been proved by test to give the best diffusion and least amount of glare, without too much absorption of light in the glassware.

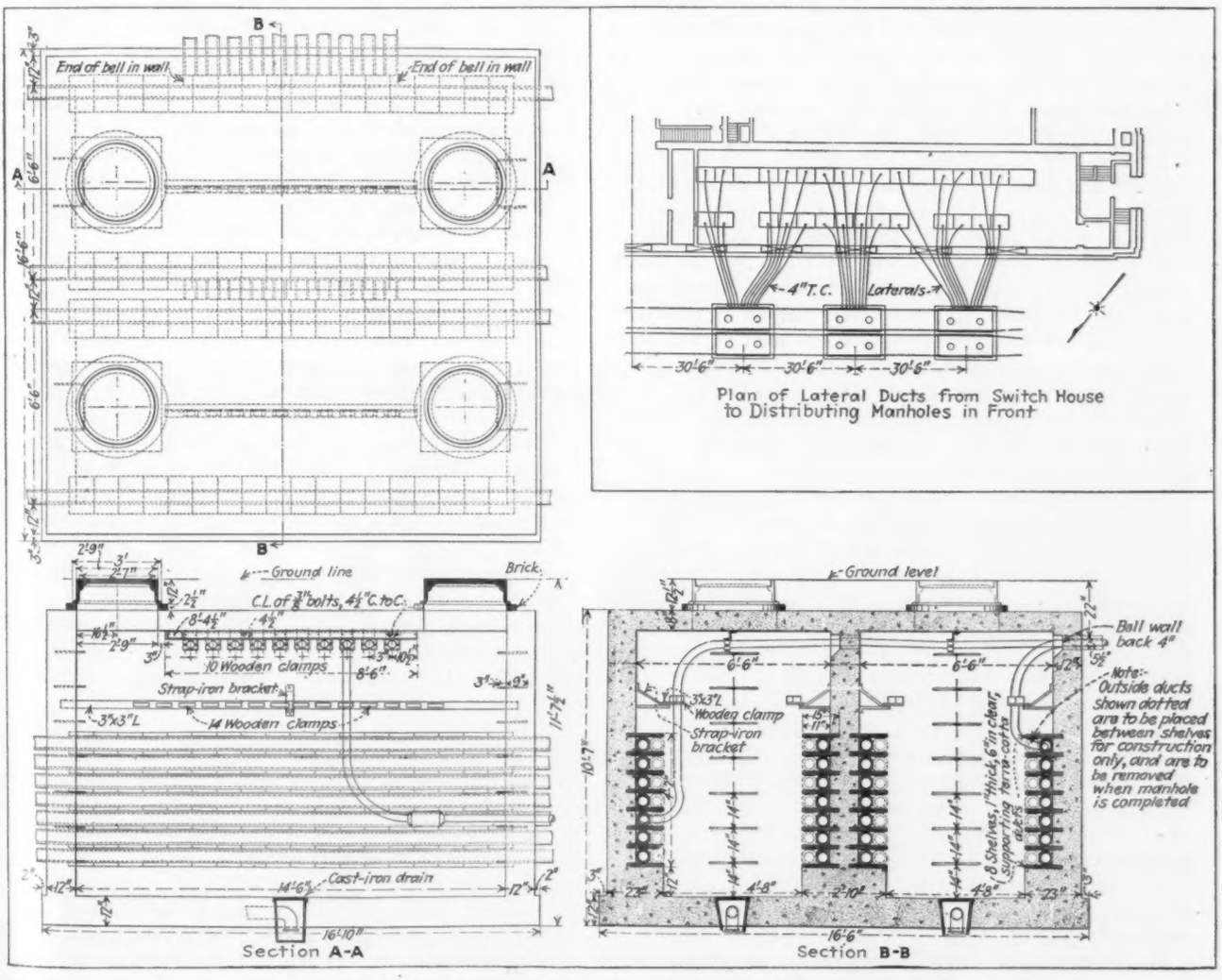
One of the Broad Street twin ornamental standards is shown in Fig. 26, similar to the standards on the principal streets in the central section of the city, all of which will be equipped with the same type of fixture and glassware and 1,000-cp. series incandescent lamps. Fig. 27 shows a single ornamental standard in use on some of the business and residential streets and main arteries of traffic. Fig. 28 shows a proposed type of post to be used on the Roosevelt Boulevard.

Part IV — The Meter and Installation Department and Its Work

AFTER a customer signs a contract for energy with a representative of the commercial department, the meter and installation department receives a "contract notice" and from that time on is responsible for getting service to the customer. Meter reading and billing, which was formerly handled by this department, is now cared for by the controller's department, leaving to the meter and installation department other servicing duties.

As the name of the department indicates, there are, among others, two major divisions, one being concerned principally with the provision and maintenance of proper metering equipment, including all testing work of the company, and the other being concerned with the installation of the meters and other incidental equipment. These are respectively the laboratories and testing division and the construction division.

The various sections of this division include the meter laboratory, meter-testing section, electrical laboratory, mechanical laboratory, chemical laboratory and photographic laboratory.



Figs. 23 and 24—Special Manholes Have Been Devised for Bringing Out Transmission Cables from the Newer Generating Stations

Fig. 26—One of the Broad Street Standards, a Type Using 1,000-Cp. Series Lamps and Used on Principal Business Streets

Fig. 27—A Type of Standard Used on Main Traffic Arteries and Some Business and Residential Streets

Fig. 28—A Type of Standard Proposed for Use on Roosevelt Boulevard, a Residential Street

The meter laboratory includes the meter storeroom, meter testing and inspection and meter repair divisions. The storeroom, storage racks, test racks and interior transportation facilities are arranged so as to facilitate testing and similar work and to reduce handling to the minimum. Meters loaded on auto-trucks are brought by elevators to the receiving room, where they are unpacked, given a high-potential test and sent to the testing division on portable meter racks. Fig. 29 shows a general view of the meter laboratory with the repair benches and test racks in the foreground and a part of the storeroom in the background. Several portable carrying racks appear in the picture. After testing and serialing, the meters are returned to the storeroom to await installation. In addition to its service in meter testing, the meter laboratory serves as the training school for meter testers, a large part of the force employed in testing meters in the laboratory being testers in training for outside work. There are sixteen standard test racks, as well as facilities for testing large-capacity meters. During 1923 more than 91,000 meters were tested here.

The repair division repairs watt-hour meters removed from service and also repairs all major defects on meters in service when they are of such a nature that the testers cannot do the work. Here also are repaired maximum-demand meters, steam and mechanical instruments used by the station engineering department and miscellaneous laboratory testing equipment, except electrical indicating instruments. Considerable testing equipment of a special nature is also built by this division.

The testing of all meters outside of the laboratory, on customers' premises, in stations or elsewhere, is done by the meter-testing section. The total force consists of about one hundred testers and twenty-five assistant testers in addition to the supervisory force. These men tested 162,000 meters in 1923, as well as making other inspections on meters which did not require tests.

The electrical laboratory is divided in accordance with the nature of the work to be done into six groups as follows: (1) Standardizing division; (2) station instrument division; (3) station testing division; (4) material testing division; (5) customers' testing division; (6) maximum-demand division. The scope of the work of this section may be seen from the following:

Standardizing Division. — Maintenance of primary standards, calibration and repair of portable electrical indicating instruments and rotating standard watt-hour meters, tests of shunts for use with large-capacity direct-current watt-hour meters, etc. Tests on these instruments are made according to a schedule specified by the Pennsylvania Public Service Commission.

Station Instrument Division.—Calibration and repair of station instruments and relays.

Station Testing Division.—Checks of wiring and initial operation, acceptance and performance tests; drying and insulation tests of new or repaired station equipment, such as turbo-generators, exciter sets, converters, frequency changers, blowers and their control equipment; also, electrical tests of installed cables and transmission lines.

Material-Testing Division.—Testing of new and used line transformers; cable, insulator and other high-tension tests; ratio tests of metering transformers; miscellaneous tests on line-drop compensators, lamps, gloves, oils, etc.

Customers' Testing Division.—Graphic and indicating instrument tests made on customers' premises to determine demand, power factor, load conditions, etc.; tests to determine characteristics of apparatus used or proposed for use by customers, investigation of trouble on customers' premises, surveys of power requirements of isolated plants.

Fig. 33 shows a special form of meter developed in the laboratory for making power-factor tests on customers' premises. It consists of two integrating meters mounted in the same case and having their current coils connected in series, one meter being adjusted to read true energy and the other modified to read the reactive component. Some notable work on the possibilities of power-factor correction has resulted from data obtained.

Maximum-Demand Division.—Maintenance and reading of all demand meters and compilation of billing data from these meters.

Mechanical and Steam Testing Division.—This division tests and maintains all boiler and engine-room instruments used for measurements of pressure, temperature, etc., and the condensate meters used in the measurement of steam supplied to customers. It also reads and computes the records of these instruments. This division also makes tests on private steam plants of prospective customers, makes temperature surveys of cable ducts and conducts mechanical tests on materials.

Chemical Laboratory.—This laboratory makes the usual routine tests on coal, oil and water, as well as many special tests, and is responsible for the proper treatment of boiler-feed water in generating plants. A particularly complete equipment for oil tests is in use. This is shown in Fig. 35 and includes a demulsibility testing machine, vacuum distillation apparatus and a sludging machine which provides a test of the resistance of oil to sludging under service conditions.

Photographic Laboratory.—A vital part of the company's facilities, constituting a pictorial history of construction work, is provided by periodic photographs. The making of lantern slides, photostats and blueprints and the operation of motion-picture machines are a part of the activities of this division. The magnitude of the work may be judged from the number of negatives made during 1923, which was approximately 4,300.

THE CONSTRUCTION DIVISION

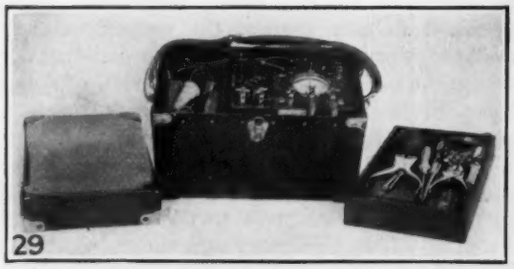
An outline of the work of the construction division of the meter and installation department may be divided into the following sub-headings: First, meter installations in residences and apartment houses; second, commercial installations for light and power, including measured maximum demand; third, industrial substations, including the switching equipment, primary and secondary work and metering; fourth, change orders and final removal of meters, and, fifth, the work of maintenance of company equipment.

When a customer signs a contract for electric service in a residence or for a small commercial light and power installation, a contract notice is sent to the inspection division of the meter and installation department, which notifies, by means of suitable order forms, the meter shop. The latter in turn assigns the proper meter to the job, and the work dispatchers of the construction division assign the order to the proper district, of which there are ten in the city. The day's work for each installation crew is then systematically routed beforehand on a "load sheet."

The meters are wired in the meter shop with wire bent on forms so as to adapt it to the service-switch terminals, and all of the necessary screws and bolts are placed with each meter in a cardboard container. The containers are placed on loading racks designated for each district and remain there until night time, when they are placed in the trucks for the next day's work. Installation trucks are arranged to carry about twenty-five meters, an extension ladder, two men and the miscellaneous material required for making service and meter connections. Each crew is assigned an average of twenty-two jobs daily; however, at various periods of the year when the work increases the jobs are more concentrated and the number of orders to each crew is proportionately increased.

The operator of each truck is in charge and installs the meter on each job, while his helper by the use of an extension ladder makes the service taps from the company's bracket to the customer's service wires. When making the service taps each wire in the conduit is tested with a magneto for grounds or short circuits, and the grounded neutral wire is properly marked at the bracket. This permits proper connection of the service neutral ground wire within the building and assures the proper meter connection in the ungrounded wire of the service on two-wire grounded services. For permanent identification of the neutral wire the installer places a red paint mark on it at the bracket and in the meter cabinet, and when the service wires have not been run the installer attaches also a red tag to the neutral wire at the bracket which contains instructions for the transmission and distribution department to make the proper service connections at

General View of Electrical Laboratory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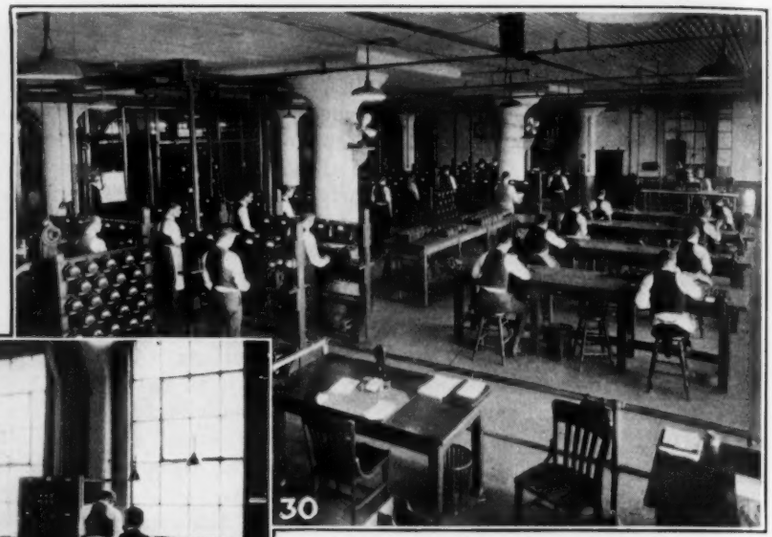
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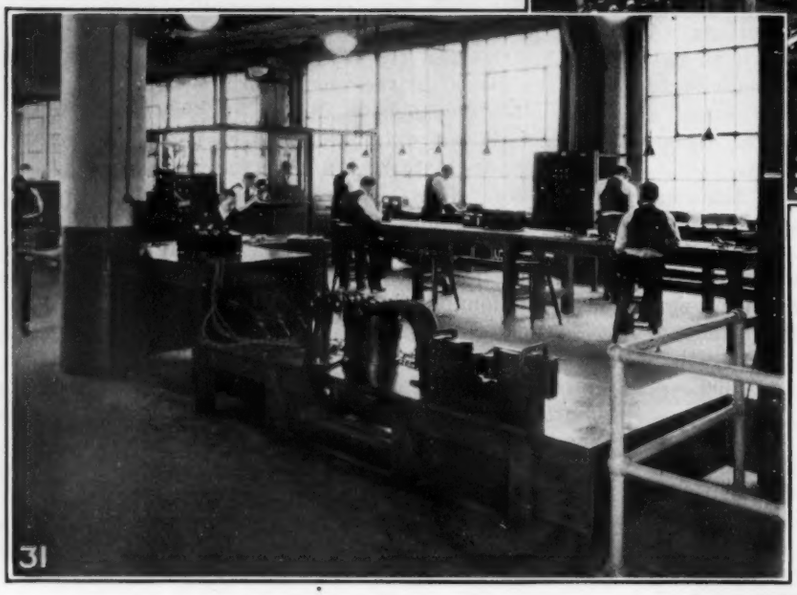
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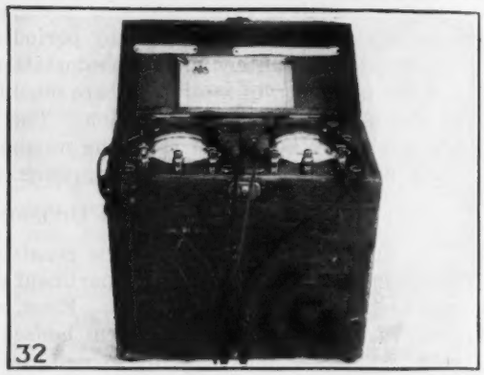
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Meter and Test Laboratory Views

Fig. 29—Portable meter-test kit.

Fig. 30—General view of meter laboratory, in which more than 90,000 meters are tested yearly.

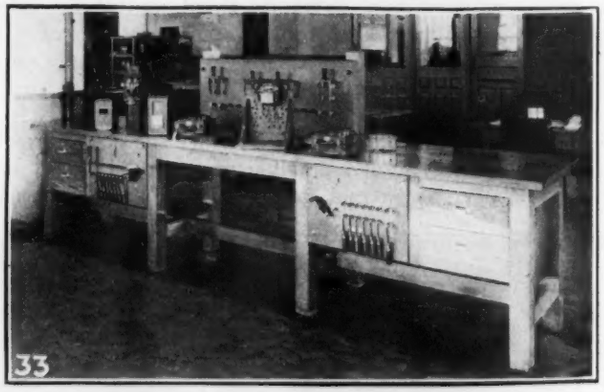
Fig. 31—View in standardizing laboratory showing equipment for testing shunts in foreground.

Fig. 32—Special meter for making power-factor tests on customer premises.

Fig. 33—A bench developed for relay testing.

Fig. 34—Oil-testing laboratory.

Fig. 35—Steam condensate test equipment.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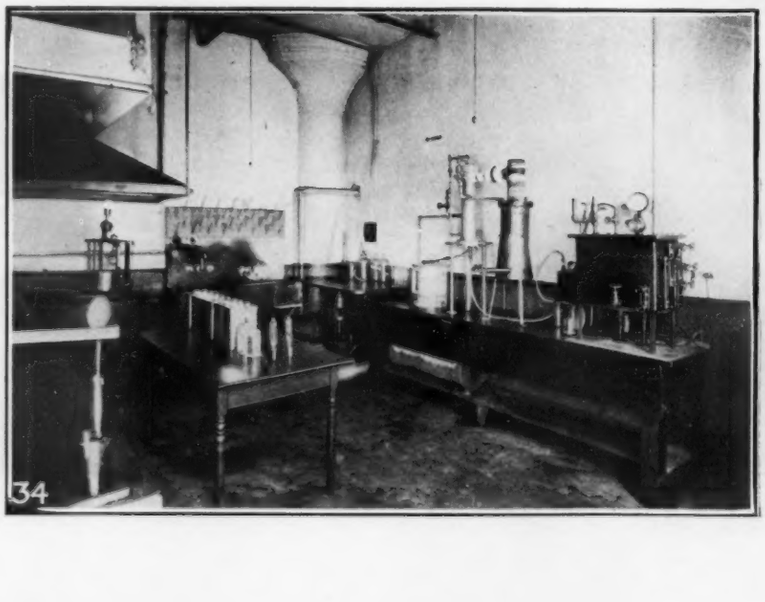
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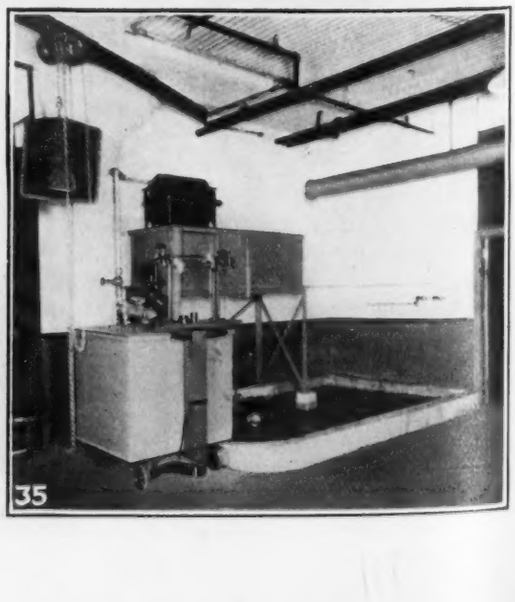
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the time service connections are established. This eliminates the necessity of the meter installers returning to make any final connections, and when the job is ready for current the service fuses are placed by the inspection division. This plan allows a prompt service to the customer, reduces much routine of orders throughout the company and practically eliminates the hazard of making service connections.

The installation crews return to the service building at 4:30 p.m. each day and turn in all of the original order sheets properly filled in, as well as the necessary data pertaining to jobs where for any reason the installation could not be completed. Each of these trucks averages 28 miles daily, and the operators are in touch with the office every two hours to receive instructions relative to any emergency or rush work which may come to hand during the day and which they take care of according to instructions.

The entire operations of crews, supervisors and others engaged are centralized and under close executive supervision in order that no trouble may occur in the routine which might hamper the rendering of prompt service to the public. All meters on this class of work are installed within twenty-four hours after the receipt of orders from the inspection division, except in those cases where for some reason the meter could not be placed. Service as quick as this is made possible partly because of the fact that all departments are established in the same building and close contact is made with the inspection division, meter shop and transportation division, thus permitting immediate communication between individuals of the several divisions. The average daily number of meters installed and changed on this class of work is 260, and the maximum number of meters installed in any one day on all classes of work is 537.

The following list shows some of the methods which tend to speed up the work without in any manner reducing the quality or introducing any personal or fire hazards:

1. Service taps made with approved solderless connectors, covered with tinfoil and tape. Installation time, eleven minutes.
2. Meters wired complete in assembly shop, cut-out ends looped. Installation time, eleven minutes.
3. All work properly routed, thus eliminating excess mileage. Twenty-two jobs per crew per day.
4. Night systematic loading of trucks. No time lost for loading. Truck in district 7½ hours. 1½ hours lost between shop, district and return.
5. All material assigned and placed in carton with meter. No losses in time or material.
6. Meters loaded with designations in same sequence as orders on load sheet. No time lost.
7. Proper shock absorbers installed on all trucks. Eliminates much breakage of dial glasses and other damage to meters and equipment.
8. Men equipped with tool belts. No time lost in locating the proper tools at all times.

A typical meter installation such as is now made in residences and apartment houses is shown in Fig. 36. This work involves about 85 per cent of the total number of meters installed.

A very useful method is used to relieve the company of the necessity of following residential jobs where the house wiring is not completed. When a customer signs a contract, the salesman notes the condition of the wiring, and if it is not completed far enough to permit the installation of the meter, the customer receives a filled-in post card, addressed to the company with instructions to mail it when the wiring is completed. Residence locations are not visited by a company inspector until thirty days have elapsed unless the wiring was reported complete or the post card notice of completion has been received.

HANDLING COMMERCIAL METERING

The next class of installations involves commercial contracts for light and power and for installations on which the maximum demand is measured. The general routine followed is similar to that for residence and apartment-house installations, except that in these cases the meter support and appurtenances are furnished and installed by the company. For meters up to 150 amp. rating which are of the self-contained type

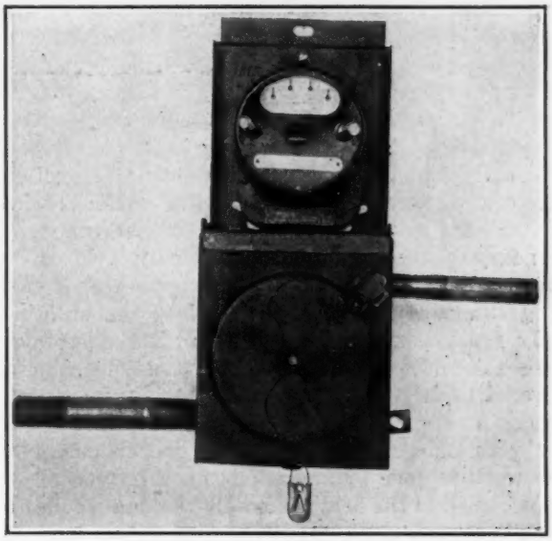


Fig. 36—A Single-Meter Installation for 5-25 Amp. Service. Type "AA" Switch Permits Access to Fuses

a support and testing device is installed and connected to the customer's service and house wires. Facilities are provided as in the case of residences for testing the meter without service interruption. On loads exceeding 40 kw., or on smaller loads where the customer desires it, the maximum demand is measured. This is accomplished with an indicating instrument on small loads, or where there is no special rate involved for off-peak demand, etc. On the larger loads, or loads involving off-peak contracts, a recording demand indicator is installed. This latter type of instrument is also used to record simultaneous demands from a light and power load when required.

Meters involving demand indicators are checked by the maximum demand division of the electrical laboratory, in order to avoid error in the operation, and as soon as such meters are installed or changed this division is notified by special form to check the demand-meter operation and so forth.

All construction work for these types of installations is done in the construction division machine shop, and the wiring and connections are made by the assembly section of the same division. This permits all jobs to be delivered ready for connection and makes a minimum amount of work necessary on the job, all of which assists in rendering quick and accurate service connection. The assembly section is used as an instruction school for apprentices, who after showing the proper aptitude are transferred to the construction forces in the field.

The complete equipment for measured-demand metering is assembled on panels for installation on customer premises or in substations, and these panels contain the complete equipment necessary to measure the energy and reactive component and their respective demands on an installation of one or more two or three phase, 13,200-volt feeders supplying an industrial substation.

LAYOUT OF INDUSTRIAL SUBSTATIONS

The next class of meter installation is that in connection with industrial substations involving 2,300-volt and 13,000-volt service, two-phase and three-phase respectively. This work is handled by special inspectors, and construction is directed by a special corps of wiremen under the supervision of a foreman. The construction involves the installation of service oil circuit breakers, disconnecting switches, transformer and meter equipment. Virtually all of the apparatus is mounted on metal panels and iron framework with asbestos compartments for the disconnecting switches. The panels and compartments are built and erected in the construction division assembly shop. Here all of the wire connections are made to the various tripping and meter current and potential transformers. The secondary connections are made with colored braid wires run in conduit, and all of the apparatus is effectually grounded to a common grounding busbar attached to the framework. When necessary for shipping, the entire assembly is disassembled in sections, and when delivered to the job it is only necessary to reconnect the sections and make the service and load connections. This plan allows a special shop supervision, and the shop work is done by specialists on this type of work. The wiremen in the field make only the final connections, and, disregarding the variation due to the location of the work, the main construction is always standard on account of the construction in the shop. Much time and material are thus saved, and a low unit cost is made possible on this class of work. Panels constructed for the larger installations are made very flexible and once installed will take care of any increase or decrease of load in the future. Apparatus of this character when removed from service is repaired and painted and used on other installations. A typical example of industrial substation construction is shown in Fig. 40.

The changing of meters necessitated by burn-outs, overload or undermetered conditions is accomplished by means of a routine similar to the original meter orders and is handled by the meter installers; but a much greater degree of supervision on the part of the district supervisor is required in order to avoid phase reversal and to minimize inconvenience to the customer. All orders involving meter or demand instrument changes are expedited in order to eliminate as much as possible complications in the meter billing division which would lead to disputes with the customer.

The maintenance division takes care of all repair work necessary to company property on the customer's premises. Industrial substations are regularly visited and all apparatus is inspected, cleaned, painted, etc., as required. Oil levels in oil switches and potential and line transformers are properly maintained. In cases where undue sludging occurs the oil is removed and a new supply placed. Repairs to all small meter supports, including those on residence and apartment-house installations owned by the customer, are taken care of by this division in order to maintain as nearly as possible continuity of service. This division also inspects and maintains all circuit-breaker settings on emergency service contracts involving a limited current capacity. The entire grounding of the secondary system of the company was taken care of by this division, so that at this time the lines are effectually grounded and at no place does difference of potential between any low-voltage service conductor and the earth exceed 115 volts.

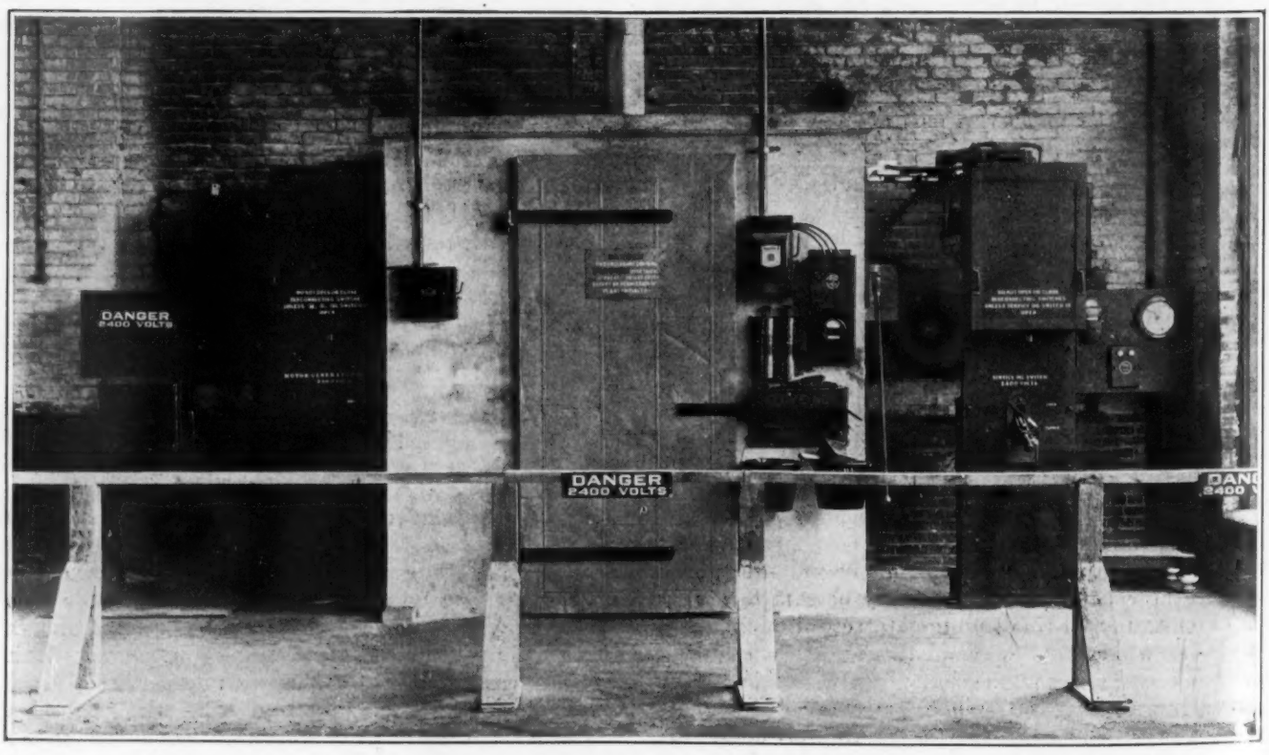
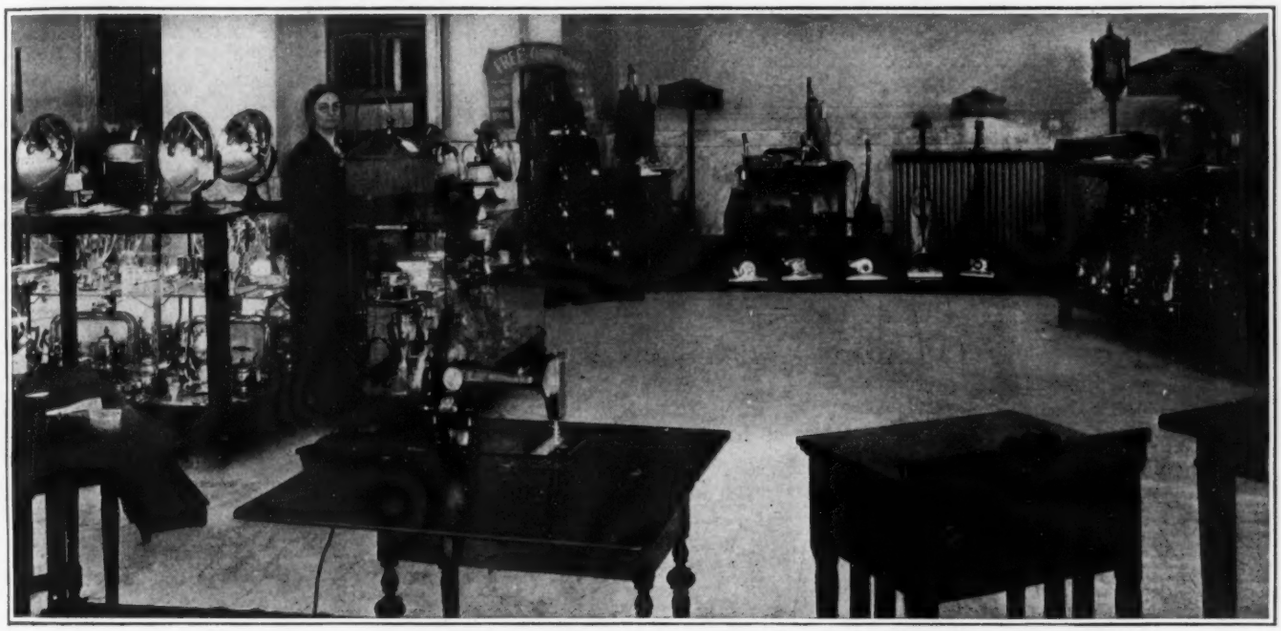


Fig. 40—A 2,400-Volt Industrial Substation, Including Metering Panels and Safety Equipment

Philadelphia Commercial Methods

By Charles J. Russell
Vice-President in Charge of Commercial Department
Philadelphia Electric Company



The Philadelphia Electric Company Has Some Very Attractive Merchandise Stores

The commercial activities of the Philadelphia Electric Company are predicated on market surveys covering all classes of business, and indicating existing as well as prospective loads. The company's phenomenal success in house-wiring campaigns is outlined.

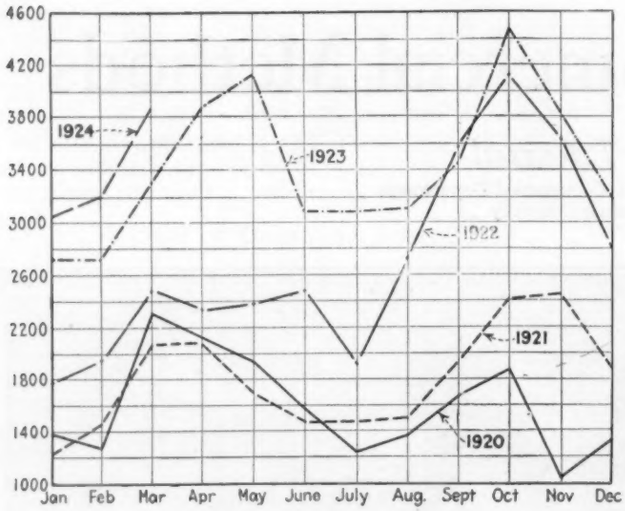
THE commercial departments of the Philadelphia Electric Company are centralized as far as policy, control and record of activities, sales and service engineering and survey work of all types are concerned. With the exception of power sales, they are decentralized through the maintenance of thirteen district offices in which, under the direction of competent managers, complete service is supplied through service and appliance sales forces, bill-collection and lamp-supply forces, and so on. This decentralization represents the perpetuation of local company organizations in a city built from the consolidation of many boroughs and townships in which local traditions, organizations and trade activities are still very powerful. The entire commercial organization reports to a vice-president in charge of these departments, and he reports to the senior vice-president.

The fundamental basis of commercial activities consists of market survey work. This covers every property in the entire territory and may be said to provide an exact and at all times up-to-date record of the measure of the existing as well as the probable future market for sales in all classes of business. From this exact knowledge it has been found possible to predict demands for capacity, output in kilowatt-hours and revenue for a period of years in advance. In the power field this survey covers all forms of power sources, their capacities, annual outputs and normal growth, as well as the age and condition of all prime movers. An industrial heating survey has just been completed, and a survey of transportation demands and methods has just been started.

General and specific knowledge as to the utility of the company's service for the ever-widening fields of energy sales is conveyed to the commercial departments through the commercial departmental branch of the Philadelphia Electric Company section of the National Electric Light Association. This branch is made the vehicle through which knowledge of the market and of the goods is obtained.

New-business effort, while based fundamentally upon survey work, has also the advantage of daily information concerning realty transactions as well as projected and actual building construction. The survey work is continuous and makes for the efficiency of the regular sales force, to which actual leads are at once referred. Sales efficiency is further improved by the elimination of transfer work from the sales force. Transfer men, provided in most cases with automobiles, take care of this very important branch of commercial work besides making inspections of vacant property. The regular sales force consists of fifty-six men, the survey force of ten and the transfer force of fifteen men. The accompanying table gives typical results of the survey.

With the growth of business and the necessity for



Unit Residence Properties Wired

revised surveys due to post-war conditions, it has been found of great advantage, when surveying a zone, to call upon customers as well as upon those not using service. Suitable advertising material is delivered to all properties visited and specific information given as to special sales and other opportunities. First-hand explanation of rates and the effect of rate reductions has been found highly beneficial.

A large amount of sales work has been devoted to the wiring of old homes for electric service. As late as 1920 there were 300,000 unwired residences in Philadelphia. This condition existed on account of the fact that Philadelphia had its substantial growth during a period when gas lighting was the standard of illumination, and it has therefore been a comparatively slow process to bring about the uniform adoption of electricity in the home.

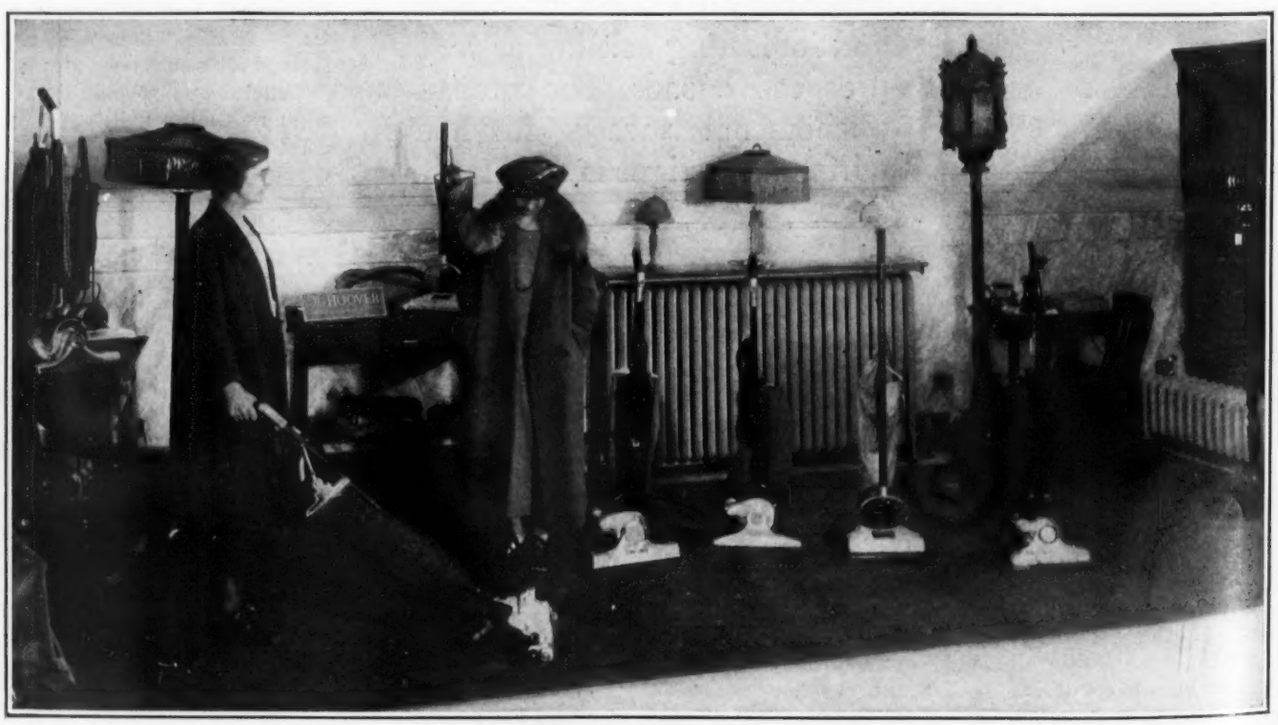
By means of a card record containing complete information on every property in the city, obtained through an extensive and intensive survey, it was possible to direct effectively the necessary selling effort to wire these already built houses. The result has been a constantly increasing number of homes added to the companies' lines each year, increasing from 20,000 in 1920 to 40,000 in 1923, with a total of 120,000 in this four-year period. There exist, then, today about 150,000 unwired properties which are in the prospect class for electric service. This represents a market which should be completely saturated within the next three or four years, since the projected sales program for 1924 includes the wiring of at least 45,000 of these homes.

The indicated volume of sales has been made potentially larger by reason of the active co-operation of the large body of contractors in Philadelphia operating in the house-wiring field. Many of these contractors employ their own salesmen, and, on account of the active competition and the large volume of work to be done, the home owner is able to obtain good work at a fair price and on extended terms of payment.

During their visits the company's representatives make sure that customers understand the lamp sales and renewal policy. Lighting conditions are examined superficially, and many suggestions for adequate illumination are made as well as references to the lighting

DATA ON SURVEY WORK OF PHILADELPHIA ELECTRIC COMPANY

	Zone No. 1	Zone No. 2	Zone No. 3	Zone No. 4
Properties visited	18,730	27,008	5,568	25,764
Customers	11,520	12,080	2,399	7,057
Non-customers	7,210	14,928	3,169	18,707
Service estimates requested	706	1,441	433	1,015
Immediate appliance leads	562	1,454	467	211
Separated as follows:				
Electric irons	161	496	90	45
Washing machines	146	269	158	81
Vacuum cleaners	178	523	156	42
Toasters	24	50	24	16
Coffee percolators	10	51	12	8
Radiant heaters	19	26	18	6
Ironing machines	4	26	2	...
Electric refrigerators	7	5	1	1
Electric fans	13	8	6	12



Vacuum Cleaner Demonstrations Aid Sales

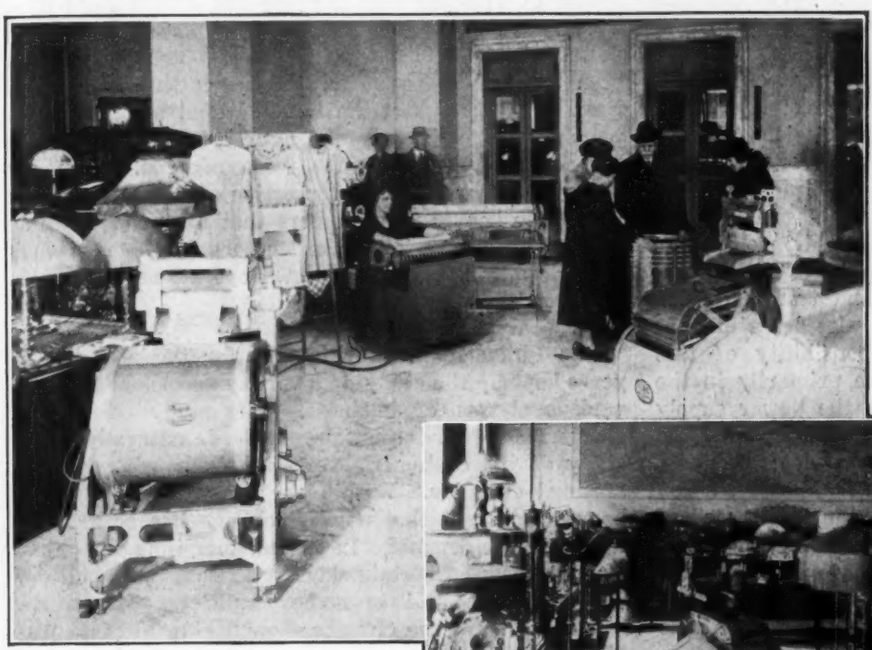
service department for free assistance on questions of proper illumination. A census of all appliances installed is taken during the survey, and if any are defective or unsatisfactory, the information is at once turned over to the proper department for repair or demonstration service.

The total expense of this survey work has been in round figures $1 per actual wiring and appliance sale lead. The real benefit of this direct contact with customers and non-users cannot, however, be measured entirely by immediate results.

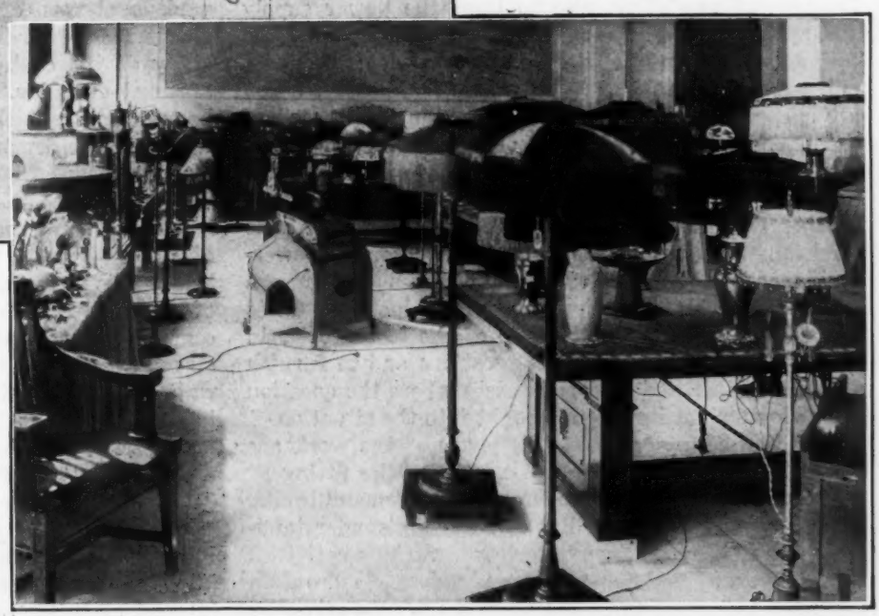
The present wiring progress in the territory is the result of this continuous survey work. Advertising material delivered as far back as eight years ago is frequently turned in at the offices or to salesmen with the request for further information. The progress of this development in the wiring of old houses is best shown by the accompanying graph, which shows the number of unit residence properties wired in the territory since January 1, 1920. The curve for 1923 is of particular interest because of a special drive made during the summer months in order to avoid the peak conditions of September, October and November, which seriously affected both contractors and the central-station service forces. It may also be of interest to note that a special home wiring campaign is now under way comprising the wiring and fixtures of residence properties together with the installation of an electric washing machine and flatiron. Up to date 1,500 contracts of this nature have been obtained upon a deferred-payment plan. In addition to these results, leads developed in this campaign resulted in 7,500 regular wiring contracts without the special features mentioned.

The survey methods pursued in Philadelphia lead most effectively to selective selling and also to special campaigns when it is deemed advisable to develop certain classes of business. Special efforts toward better illumination in industrial plants, stores and residences are continuous rather than of the campaign type, although in all these classes of business highly successful drives have been made covering limited periods. As an instance of this a recent "sunshine unit" campaign may be mentioned which resulted in the installation of 40,000 units of 100-watt capacity.

For years the company has maintained a lighting service department. The work done by this organization, now consisting of four men, does much to maintain good relations with the public and with customers. Free service along the lines of illuminating engineering is given to architects, engineers, builders and customers, including the preparation of plans and specifications for new or revised installations. In the past year this department has received 905 original service requests and 665 complaints and prepared 123 plans and specifications for prospective customers.



Washing Machines Attract Interest When Demonstrated



Another View in the Main Appliance Store

By the close co-ordination of the commercial department, the inspection division and the meter installation division exceedingly prompt and efficient metering service is rendered to new customers. Hectograph copies of the contract order, issued by the commercial department, are simultaneously distributed to the various departments concerned in the routine necessary to furnish service and make proper records for the new customer. At the time of signing a contract each new customer receives a form postal by which the inspection division can be notified that the wiring is sufficiently advanced to render possible the installation of metering equipment. Immediate inspection of the premises is then made, frequently on the same day that the postal is received, and if the customer's wiring is satisfactory the meter installation order is issued at once. Within the next twenty-four hours the meter is installed and connection is made.

With sales for industrial power to railroads, street railways and adjacent public utilities amounting to 750,000,000 kw.-hr. per year, the importance of a highly organized sales force to handle this business is at once apparent. There are seventeen salesmen and a power service force of nine men engaged in this work under the direction of a manager who reports to the vice-president in charge. All power cases of 7½-kw. capacity are handled by this organization. The salesmen work on assigned cases which arise from the power survey as to existing plants, from realty and other sources as to new plants, and from office inquiries. With the exception of specialists the men work in zones and to each is given a bogey for the calendar year. The power service division of this department is of great impor tance in the promotion of good relations with customers All matters relating to rates, tests and examination of existing installations, lay-outs for extensions or new motor installations and complaints of every kind are handled by this division.

With the great growth in power business it has become more and more necessary to avoid machine-like handling of customers and to keep in close personal touch with their operating needs and troubles. The power service division of the power sales department is particularly charged with the responsibility of this work. The company's customers are primarily in the business of producing, and to them the power supply and application is an incident which they are prone to forget until the question of cost or service difficulties is brought home to them. To handle these cases, which are surprisingly large in number, a complete record of customers' operation on the company's lines is maintained through duplicate bills. Every effort is made to pick up changes in load cycle which might make another rate more applicable before the customer asks for help. Suggestions are made as to motoring, power-factor correction and load-cycle changes to improve operation without interfering with production. Tests are also conducted with the help of the laboratories in order to establish bases for suggestions and to furnish data for competitive reports in cases where the question of a private plant has been brought into the situation.

The data accumulated in this phase of the work are available, through a classified index, for the fitting of new customers with the proper rate and demand limits. By this means the possibility of future misunderstanding is minimized. In pursuing these various activities in 1923 more than 2,600 calls were made and more than 250 misunderstandings were cleared up. Twenty-four competitive reports were prepared, and more than 900 operating reports and rate analyses were completed.

One very interesting branch of modern installations is found in the refrigeration industries, which now represent a demand of 15,000 kw., with an annual use of 75,000,000 kw.-hr.

Philadelphia became early in the world war a great center for the manufacture of munitions. When this business became still greater with the entrance of the United States into the war extraordinary demands for power resulted. Very high standards of power-factor requirement were put in force at that time. The importance of this step with connected loads aggregating more than 150,000 hp. for machine tools, hoisting and similar work will readily be understood. The general subject of power factor has brought about a tremendous amount of discussion and, as the French say, has caused much ink to flow. The benefits to both customer and company of the addition of loads to the amount just mentioned at power factors close to unity were so evident that the Philadelphia company decided to adopt power-factor standards of 80 per cent for installations with an assessed or measured maximum demand of less than 50 kw., of 90 per cent between 50 kw. and 1,000 kw. and 95 per cent for installations in excess of 1,000 kw. The establishment of these standards has, without resistance or friction on the part of customers, led to the further installation of 25,000 kva. of corrective apparatus. In one group of customers starting off with a demand of 12,395 kw. and 16,003 kva. at a power factor of 77.2 per cent lagging the final results have been a demand of 14,595 kva. and 15,308 kva. with a power factor of 95 per cent. In this group it will be seen that, in spite of an increased demand, due to growth, of 2,200 kw., the total demand upon the company's facilities is, in round figures, 700 kva. less than before corrective measures were adopted. In many cases it is found that the correction of low power factor is of such benefit to customers that they will go to as near unity as possible in order to gain the maximum possible advantage in their own operations.

RESIDENCE LOAD SURVEYS

The Philadelphia company has for the past twenty years kept up the study of diversity and load factors in various classes of business. The study of graphic charts from distribution circuits leads naturally to the study of the customer's variation in hourly, daily or seasonal demands. Within the last few years it has become apparent that a great change has occurred in the residence demand. In the summer time the circuit records show on certain days practically as much day load as night load in some localities. The winter records of residence circuits show during the first part of a week over 50 per cent as much day load as night load. This remarkable change is due to the introduction of electrical appliances for household use. As an outcome of this movement appliance sales policies have been strengthened materially. The sale of additional kilowatt-hours in existing installations without additional investment for facilities to supply them is universally recognized as of the greatest benefit to the utility, and the introduction of labor-saving and comfort-bringing devices in the home will do more to popularize the general use of electric service than anything else.

The residential survey division is constantly engaged in visiting both customers and non-customers in the interest of better service to the community. Company representatives talk to the householders about service, lighting and appliances, listen to complaints and suggestions for the improvement of service, inform them concerning lamp renewals, suggest improvements in lighting, ascertain whether the appliances used are working properly, find what appliances are not used and give practical advice about the general operation and use of all sorts of appliances used in the homes. They also call at unwired homes, ascertain the names of owners and tenants, the condition of the property and the state of mind of the owner as to electric service. The company gets complete information as to its ability to serve any "prospect" and gains information useful in designing line extensions. It is interesting to note how few complaints of service to the householder are received and the general satisfaction among residential customers. It has been and is a splendid point of contact between the central station and the customer, and in

addition has been most valuable in many ways in its advertising and sales aspects.

It is the belief of the Philadelphia company that rate schedules should be as simple and contain as few rates as possible. Special rates are looked upon with disfavor and the necessity of absolutely standardized practice is recognized. The present rate schedules represent a carefully balanced tariff with like charges to all for like conditions of supply.

APPLIANCE SELLING AND GENERAL POLICIES

In a general way, appliances are being sold today in very much the same way that they were sold five years ago, though the present-day methods are perhaps more intensive. Electric appliances are specialties, not staples, and it is still just as necessary to go direct to the housewives with the electric appliances as it was five years ago.

The Philadelphia Electric Company from time to time makes special offers which are widely advertised, using a style of advertising copy which has originated, so far as its use by the central station is concerned, with this company. This advertising has been productive of phenomenal results, and it is now being used successfully by a great many lighting companies.

The appliance business of this company in the last four years has increased from a total of $225,000 to more than $1,500,000. The company attributes part of this growth, as well as the fact that the business has shown a net profit, to the policy established several years back of obtaining from outside of its organization to head the appliance department men who have shown merchandising ability.

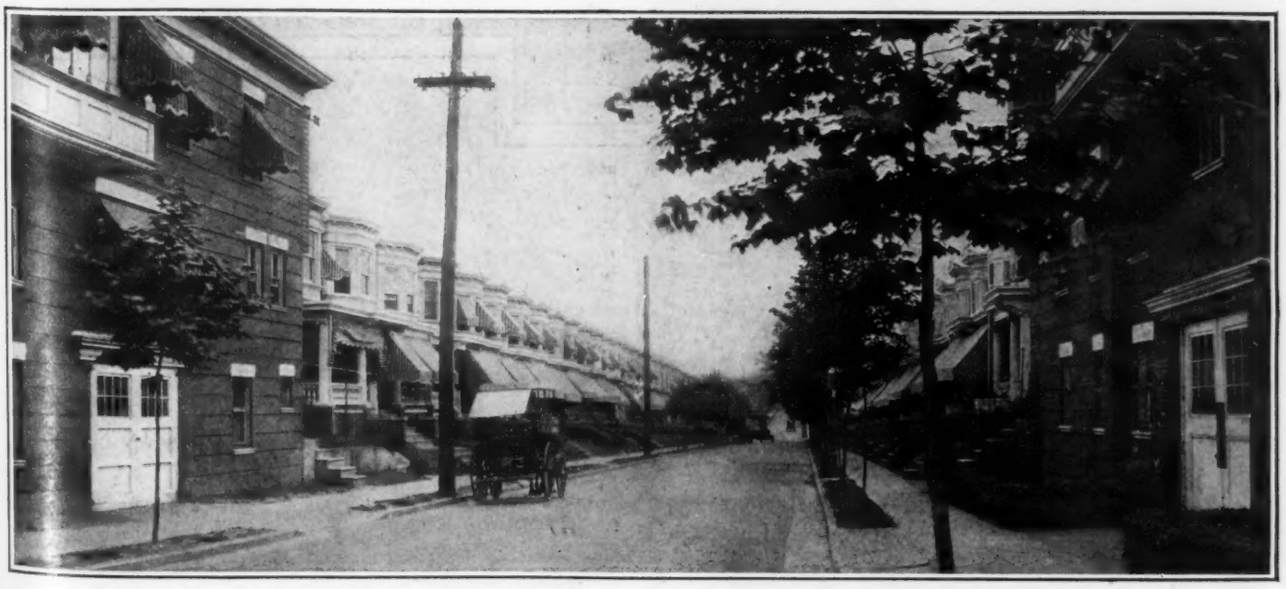
Extensive Use Is Made of Secondary Racks on the Rear of Houses

In the company's opinion, the successful selling of electric appliances is a job that must be handled not by a central-station man but by a merchandising man, and the results obtained have seemed to prove that this belief was well founded.

There are certain evils connected with house-to-house sales methods, but there is to offset this, besides the business obtained, a direct contact with the residential consumer which can be had in no other way: By house-to-house canvassing every one of the residence consumers is called upon at least once every three months, which keeps before them the progressive manner in which the lighting company is operating. This customer contact is of exceeding value.

Electric shops are maintained in all the district offices of the company, and at the main office an effort is made to have the shop not only efficient from the selling standpoint but also pleasing to the eye. For the last few years there has been a net profit, after all expenses in the appliance department have been charged against the business, which investigation shows not to be the case in the great majority of central-station appliance departments. The profit has in no small degree been due to the proper purchasing of merchandise which can be sold in quantities. The company has adopted the method of the department store, where the head of the department conducts all of the negotiations with the manufacturers.

There is nothing spectacular in the methods or achievements of the Philadelphia Electric Company. It has simply attempted, brushing aside the thought that it is a monopoly, to follow the constructive business principles found successful in other undertakings.



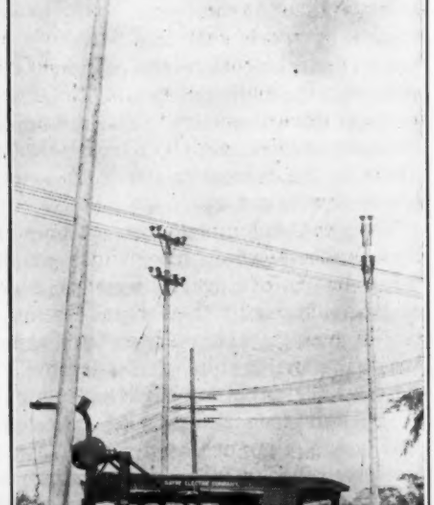
A Typical Residential Street in Philadelphia

Utility Construction Devices

By W. S. Barstow
President W. S. Barstow & Company, New York

IN ANY computation of the cost of public utility service not only does the interest on money itself enter to a very large extent but the efficient expenditure of such money is also an all-important factor. Attention continues to be called at frequent intervals to the increasing cost of construction due to the higher prices of labor and material. As these costs are established to a great degree by the markets existing at the time, the only way to effect a reduction is to employ less material and less labor to accomplish the same results. The necessity of reducing costs has brought about great improvements in central-station and transmission-system construction whereby, to a large extent, machinery replaces manual labor. As time is an important element in the reduction of costs, such machinery has been developed not only to do the same work as manual effort but to do it in less time.

A number of these devices have been developed by engineers on the properties controlled by the General Gas & Electric Corporation. Hardly a day passes with-



out a successful attempt being made to extend the lines of labor-saving devices still further in order to reduce construction costs to a minimum. Not only is machinery taking the place of labor in the original construction, but it is tending more and more to increase reliability of service by demonstrating its ability to meet instantly and in the most economical manner all conditions of emergency.

Striking examples of resourcefulness and efficiency in overcoming emergency were given recently by the Metropolitan Edison Company of Reading, Pa., in the construction of the Reading-to-Easton section of the Pennsylvania-New Jersey superpower system. Confronted by a shortage of labor which greatly curtailed its force and by extremely unfavorable weather conditions, the company, by the adoption of many different kinds of automotive equipment, was, despite these obstacles, able to complete construction well within the estimated time and at a cost much under that estimated.

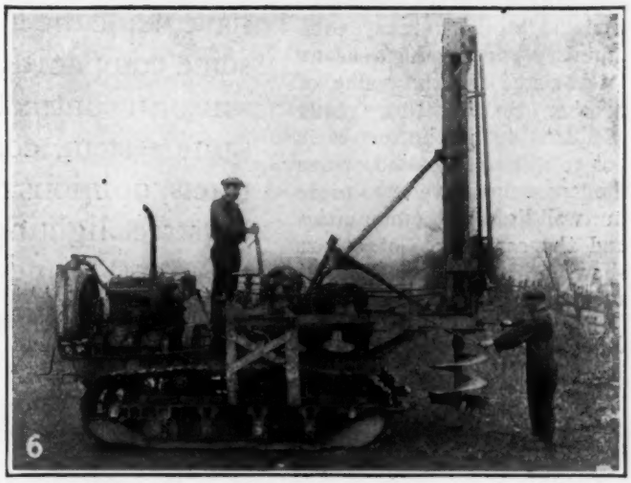
As a result of this experience in the construction of the Reading-Easton transmission line, the Metropolitan Edison Company and its associate companies have become pioneers in the general use of mechanical equipment for work formerly done by manual labor. To the portable derricks, tractors of varying sizes, trench-digging machines, pole-hole-digging machines, portable air compressors for the operation of hoists, spades, tampers and nut-tightening devices (the latter being especially efficient for putting together steel towers of transmission lines) the companies are from time to time adding new labor-saving devices.

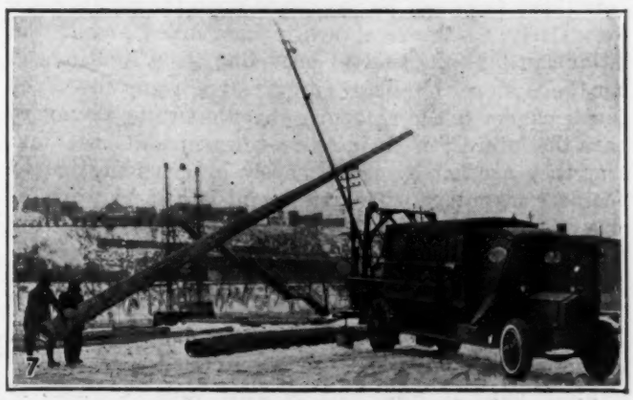
The portable derricks and most of the other equipment have been designed and built in the company's own shops. The portable derrick lends itself to many uses in transmission-line work. The steel derrick boom is bolted to the rear of a 3-ton truck and is operated by a winch driven by motor with control at the driver's seat. The boom is removable, and when not in service the truck is used by linemen, space being provided for tools and equipment needed in their work. Four of these derrick trucks are in service.

The pole-hole-boring machine used by the companies bores a hole in the earth to the required depth, and the portable derrick then lifts the pole and plants it, the entire job requiring a comparatively short time and only a few men to operate the machinery.

The rock drills, spades and tamping tools operated by portable air compressors were found so efficient that twelve are now in use throughout the territory of the Metropolitan Edison Company and other companies of the General Gas & Electric Corporation.

The 40-ton trailer used by the Metropolitan Edison Company was built over night in the company's shops to meet an emergency which arose when it became necessary to move a large transformer in order that the new transmission line might be put into operation on time. The result is that the unloading and prompt delivery of heavy transformers is no longer a problem.





Labor-Saving Devices that Are Being Used Daily by the Metropolitan Edison Company

Figs. 1 and 2—Pole-raising machine in which pole is placed on pulley and is set by backing the automobile.
Fig. 3—Excavating for a conduit.
Fig. 4—This 40-ton trailer insures prompt delivery of heavy transformers.
Fig. 5—Five-ton tractor for heavy duty.
Fig. 6—Pole-hole-digging machine.
Fig. 7—By picking the pole up horizontally this truck can carry it over a fence or wall as high as 25 ft.
Fig. 8—Portable air-operated apparatus found very efficient.

Making Street-Lighting Business More Desirable

By Allen M. Perry
Western Editor ELECTRICAL WORLD

In this article are outlined the value of adequate illumination in thoroughfares, conditions which have made the load unattractive to some companies, tendency toward uniform contracts and rates on the same system, comparison of contracts, opinions of executives, data on street lighting costs, operation and rates

STREET lighting of some kind is recognized as a necessity in every city, town and village, but if the conditions existing in many communities can be taken as an indication, the value of making the lighting really adequate to public needs is not so well appreciated. None the less, exhaustive tests made in well-lighted communities and the experience of others show quite conclusively that adequate street lighting minimizes traffic accidents, discourages crime and consequently increases personal safety on the street, in the home and in the office. Furthermore, good street lighting enhances the value of real property and attracts business.

If these facts can be impressed upon the public more extensively by the local utility companies and if the latter can take the lead in providing good lighting, as has been done by many progressive companies, the people cannot fail to recognize that the utility managers have the interest of their fellow-townsmen at heart and that they are not actuated merely by consideration of business advantage. This viewpoint is held by progressive utility executives, several of whom have assured the writer that they believe street-lighting service, if properly conducted, has great possibilities as a means of improving public relations.

Adequate street lighting also stimulates citizens to increase their individual use of electricity by demonstrating publicly what can be done with it. This is particularly true where the interiors of residences or other buildings along well-lighted streets are inadequately lighted and form a violent contrast with the thoroughfares.

The direct revenue from street-lighting service is, of course, another advantage to the company, though one which has often been discounted by utilities that have not been able to secure adequate rates for this service. The amount of energy which will be consumed annually by street lamps can be estimated from the fact that one 100-cp. series lamp burning from dusk to dawn will consume about 290 kw.-hr. a year (including energy to overcome losses) and a 600-cp. lamp will consume 1,364 kw.-hr. A hasty calculation will show that, if lamps are placed at every street intersection and there are two units between blocks (assuming ten blocks per mile), then 100-cp. lamps burning from dusk to dawn will in a small city with only 20 miles of street consume about 87,000 kw.-hr. yearly. If twenty 250-cp. lamps were substituted at through street intersections, the annual consumption would be increased to about 95,000 kw.-hr.

In the foregoing outline allusion has been made to existing conditions that have made street lighting unattractive to utility companies. It is recognized that street-lighting contracts have been closed in many communities at rates which are unremunerative or only slightly profitable, just to obtain a franchise or to furnish a base load in developing the use of electricity. It is also realized that with short-term contracts (less than five years) such as have been in vogue it is impossible to retire the investment without charging rates which are relatively high and either unattractive to the public or not conducive to improvement or extension of the lighting. At the expiration of such a contract it has not been unusual for the municipality to insist on changes in the equipment to take advantage of some new development, so that the utility could not rely on spreading the retirement charge over a longer period in expectation of a renewal of the contract.

On the other hand, where long-term contracts are in force some utilities have complained that an abnormal increase in the cost of operation made contracts unprofitable which were originally profitable. Still, these same companies admit one value of long-term contracts, namely, that they permit a smaller charge for retiring the investment and consequently make it possible to offer rates that are more conducive to enlargement and improvement of the system. In some cases the change in operating expenses has been taken care of by a clause that permits adjustments subject to commission approval.

Indeterminate-term contracts providing for annual adjustment of prices (based on changes in amount of special investment devoted to street lighting for lamps, cost of maintaining circuits, price of energy, etc.) have been found somewhat complicated to operate from an accounting standpoint, but otherwise very satisfactory, according to one company which has had considerable experience with this form of contract.

Most companies which have financed and owned ornamental street-lighting installations have found that the rates necessary to retire the investment must necessarily be very high. This is true particularly with short-term contracts, which seem to be almost the

only basis on which ornamental street lighting can be obtained. Furthermore, the type of standards, number of lamps per standard, location of lamps, etc., have undergone so many changes, as has public opinion itself, that there is no certainty as to the period for which the investment will bring a return.

One of the most serious detriments to street-lighting business at the present time is that the utilities as a whole do not insist upon making their contracts remunerative. As already intimated, this has probably resulted in some instances from the past practice of making concessions in rates just to obtain or renew a franchise. When this is done subsequent increases in rates are very difficult to obtain. Unremunerative rates

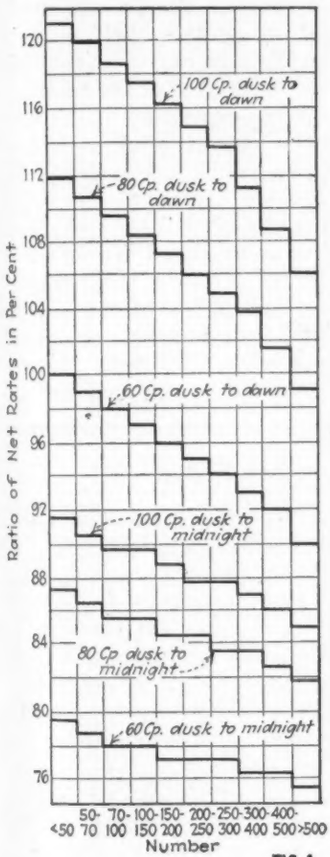


FIG. 1

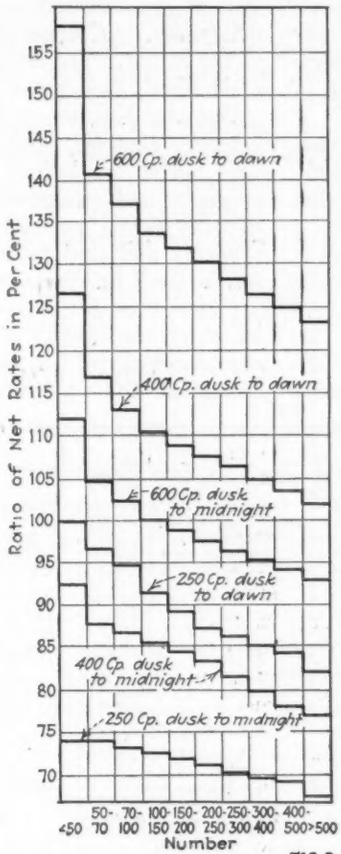


FIG. 2

Figs. 1 and 2 — Comparison of Scientifically Determined Street-Lighting Rates Offered by One Company in 200 Communities

In the two groups of curves presented the rates offered by one company to all communities in its territory are compared on a percentage basis for different sizes of lamps, different numbers installed, and for 4,000 and 2,000 hours' use per year. In the case of the 60, 80 and 100-cp. lamps the rate for less than fifty 60-cp. lamps burning dusk to dawn (4,000 hours per year) is arbitrarily assumed as 100 per cent. For the 250, 400 and 600-cp. lamps the rate offered for less than fifty 250-cp. lamps burning dusk to dawn is taken as the base. If it is desired to compare the rates of the 250, 400 and 600-cp. lamps with those for 60, 80 and 100-cp., multiply the 250-600-cp. percentage scale by 2.05. These proportions apply only for bracket-supported lamps equipped with radial-wave reflectors served from overhead lines on a ten-year contract basis. Separate, additional, uniformly-applied charges are made for providing center suspensions, prismatic refractors, and for contracts of less than ten years' duration. The rates on which this comparison is based were scientifically calculated from actual cost of all equipment involved, cost of maintenance as obtained by experience, and allow for the relative energy consumption of different-size lamps, hours of burning, and rate discount earned by reason of relative consumption of energy. Rates have also been scientifically determined and are being offered uniformly by this company for other periods of burning, such as dusk to 2 a.m., 1:30 a.m., 1 a.m. and 11 p.m., as well as special morning lighting for winter days. The rates apply to overhead service only.

have a further far-reaching effect in that they make it exceedingly difficult to obtain adequate rates in adjacent territories.

TENDENCY TOWARD UNIFORM CONTRACTS AND RATES

Among utilities operating in several communities there is a notable tendency to employ uniform contracts and rates for street lighting. This does not mean that the same rates are offered regardless of the type and size of the system or number of burning hours, but a system of rates has been devised which can be applied to any community provided the requirements outlined in the rates are met. Adoption of these uniform contracts, forms and rates makes it a much simpler matter than formerly to close business with a given community without argument as to rates existing in another community on the same system.

FEATURES OF SOME CONTRACTS

On one system in the Middle West, serving in the neighborhood of 160 communities and having 100 to 110 street-lighting contracts, a standard form of contract is made available to the district managers in printed form so that they can prepare contracts without consulting the legal department except in unusual cases. The contract (which is reproduced here) covers conditions encountered in serving boulevard as well as overhead systems. Inappropriate parts can be eliminated, and special circumstances can be covered in a blank space left for the purpose or on attached riders.

For use in conjunction with these contracts a form of resolution has been drawn up in printed form for the legislative body authorizing the contract to sign. In cities or villages this resolution requires the signature of the commission or council and authorizes the execution of the contract by the mayor, president or clerk. In townships a resolution must be signed by the township board authorizing the supervisor and clerk to execute the contract. After the contract is prepared, but before execution, duplicate copies are forwarded to the central office for approval of the rate and legal departments and for execution by the executive officers of the company.

The rates, which are uniform for all communities served, are filed with the state commission, referred to in the contract, and copies are attached as part of the contract.

Going into the details of contracts employed by the Consumers' Power Company, Jackson, Mich.; the Detroit Edison Company, operating in ninety-three communities; the Kansas City Power & Light Company, the Milwaukee Electric Railway & Light Company, the Nebraska Power Company, the Illinois Power & Light Company, and one other Middle Western company, it has been found that, with the exception of the Detroit

RELATIVE CHARACTERISTICS OF SERIES GAS-FILLED TUNGSTEN LAMPS

Amp.	Cp.	Volts	Watts	Wattage Increased 10 per Cent for Loss
6.6	60	7.0	46.2	50.8
6.6	80	8.6	56.8	62.5
6.6	100	10.0	66.0	72.6
6.6	250	23.3	153.8	169.1
15.0	400	14.8	222.0	244.2
20.0	600	15.5	310.0	341.0

Edison contracts, which are very simple indeed, they cover the following points more or less in detail: (1) Who shall supply, install, operate, maintain and furnish energy; (2) term of contract; (3) description of system; (4) ownership and financing; (5) burning hours; (6) rates for original installation with provisions for (a) minimum bill or load, (b) change in cost of operation, (c) lighting during extra dark days, (d) deductions for outages, (e) changing location of units, (f) changing size or kind of units, and (g) changing number of units; (7) what constitutes the utilities' obligations in rendering service, and (8) payment of bills. Methods of handling some of the foregoing conditions are entirely omitted from some contracts while others go into them with more or less detail. Provisions for assuring an appropriation of money to pay lighting bills, for facilitating easements and for minimizing malicious damage are also included in some of the contracts.

Installation and Operation.—Practically all the contracts referred to stipulate that the utility shall install, operate and maintain the lighting system and furnish the energy.

Term of Contract.—While the term of the contract is left open for filling in in each specific case, there seems to be a preference for ten-year instead of the shorter-term contracts for the reasons outlined previously. To permit adopting a contract term which will meet the desires of the individual community served, one company specifies all of its rates on the basis of a ten-year contract and then adds that in case the contract is for a period of less than five years an additional charge of $2 will be added to the annual price for each lamp, and if the contract is for five years and less than ten years, $1 will be added to the annual price of each lamp.

One large company in the Middle West has recently incorporated as its standard ten-year contract, which is the longest-term contract permitted in that state, certain adjustable features which allow for changes in the cost of coal and labor annually. Since the investment in street-lighting equipment was a considerable item to amortize over ten years, the retirement of the investment is spread over fifteen years and provision made that if the contract is not renewed for an additional five years, the unamortized investment shall be paid to the utility. The municipality may renew its contract after ninety days prior to the expiration of the contract.

One city has the option at the expiration of the first ten-year contract, and at the expiration of each five-year period thereafter, of purchasing the entire plant, property and equipment devoted exclusively to street lighting at the "cost to the company of the entire plant, property and equipment, less accumulated depreciation, which shall be computed at 3½ per cent per annum."

Description of System.—Descriptions of the system on which the various phases of the contracts are based are incorporated in various ways. In some cases a list of all the equipment involved in the original in-

Features of a Standard Contract Form Used in Any Community on One System

1. In consideration of the payments hereinafter provided for, to be paid by the municipality to the company, the company agrees to furnish the municipality with street lighting service, from an overhead street-lighting system owned by the company, involving an initial installation of the following incandescent lamps:

Number	Cp. or Watts	Type of Support
.....	.....	.....
.....	.....	.....

all of which said lamps, together with all station, distribution and lamp equipment, shall be owned and maintained by the company.

In further consideration of the payments hereinafter specified, to be paid by the municipality to the company, the company also agrees to operate the boulevard street-lighting system in said municipality. Said boulevard street-lighting system involves an initial installation of

Number of Posts	Multiple or Series lamp	Cp. or Watts
.....	.....	.....
.....	.....	.....

together with the globes, all of which are owned by said municipality or the adjacent property owners. The company owns the underground cable and foundations for posts.

The locations of the various classes of lamps to be furnished and operated under the terms of this agreement, are shown in the plat hereto attached and made a part hereof.

2. The company agrees to furnish the energy, labor, material, supplies and attendance necessary to operate the lamps constituting said initial installation, and also to operate any additional lamps of standard type and rating which may be ordered from time to time by the municipality and installed by the company, under the terms of this agreement. The company shall promptly renew all burned-out, broken or defective lamps and globes and shall keep the same in a practicable state of cleanliness. It is agreed that the company shall maintain the entire boulevard system, including the portion thereof owned by the municipality or adjacent property owners.

3. The service lines necessary to supply the energy to said street-lighting system shall be erected in the public streets and highways of said municipality, or on private property, as mutually agreed upon between the company and the municipality. In cases where lines are to be erected upon private property the municipality shall obtain and furnish to the company adequate written easements covering permission to install and maintain such lines.

The lamps constituting the overhead street-lighting system shall be hung from span wires suspended from wooden poles, or supported by brackets attached to wooden poles, as may be mutually agreed upon between the company and the municipality.

4. The following lamps shall be lighted from dusk until dawn each night, being approximately 4,000 hours per year:

.....

The following lamps shall be lighted from dusk until 12 o'clock midnight each night, being approximately 2,000 hours per year:

.....

The following lamps shall be lighted from dusk until.....each night:

.....

The following lamps shall be lighted from dusk until.....each night:

.....

5. The municipality may from time to time order changes in the location of any lamps theretofore installed, and the actual cost and expense of making such changes shall be borne by the municipality.

6. The company will install at its expense and operate and maintain any additional overhead lamps of standard type and rating at such times and at such locations as directed in writing by the municipality's commission council board; provided, however, that no new lamps may be ordered installed during the last year of this contract, and provided further, that in case extensions of overhead lines shall be required to operate additional lamps, the cost of making such extensions and installing such additional lamps shall not exceed three times the annual revenue to be derived from such additional lamps.

In case the municipality shall order extension to the initial boulevard lighting system, the municipality or adjacent property owners shall thereupon furnish the original posts, globes and lamps, and the company shall furnish, install and maintain the underground cable and foundations for posts. The company will also erect, wire and paint the posts and maintain the entire system. It is agreed, however, that the municipality shall not be permitted to order the installation and operation of a less number than..... additional posts and lamps.

All the additional lamps shall be operated and maintained subject to the company's standard street-lighting rates and upon the same terms and conditions as the initial installation. The additional lamps so ordered and installed shall be taken and accepted by the municipality for the remainder of the term of this contract.

7. The company does not guarantee uninterrupted service for street lighting and shall not be liable for interruptions or cessations of the service arising from damage to the street-lighting equipment or occasioned by the elements or any other cause or causes beyond the company's control.

8. It is agreed that whenever the municipality shall report to the company that any lamps constituting said entire street-lighting systems are not burning during lighting hours the company shall, with reasonable promptness, repair or replace such lamps, and it shall also keep a record of all outage and shall make pro-rata deductions from its monthly bills for all lamps which remain out of service for more than .....hours after receiving such report.

9. The municipality shall pay the company for the above described street-lighting service in accordance with the company's standard street-lighting rates as presently filed with the Public Utilities Commission, a copy of which rates are attached to and made a part of this contract. If at any time during the term of this contract new and different rates applicable to said street-lighting service are filed with and approved by such commission, such rates shall from the date of the approval thereof supersede the present rates and become and be the rates applicable to this contract.

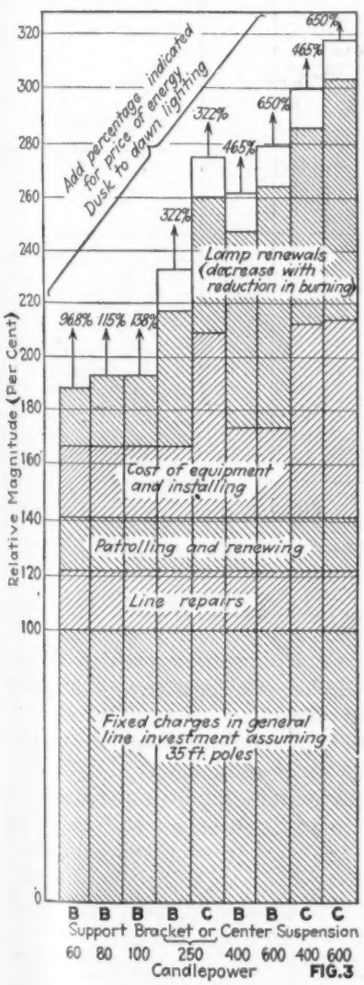
Payments shall be due and payable on or before the.....day of each month for service rendered during the preceding month. Bills for such service shall be rendered by the company as nearly as may be on the first day of each month.

10. This contract shall be effective from....., 19...., and shall continue in effect for a period of ten years from and after such date. This agreement, when effective, shall supersede all existing agreements between the parties hereto with relation to the street-lighting service hereby provided.

stallation is included with the rates per lamp. In other cases a list of all the equipment, including the original installation as well as that which might be selected for future installations, is included with the respective rates. Where only the original equipment is described, the contract usually provides that a list of any additional equipment installed shall be made a part of the contract. As a general rule, the number, candlepower or lumen rating, type of lamp, method of support, and whether service shall be rendered by overhead or underground circuits, are stipulated. In some cases the utilities go into more details and specify the kind of fixture or refractors, mounting heights, separation of units, kind of current or voltage control and location of units. There is not much uniformity between systems regarding the way in which the installations shall be described or the extent to which they shall be covered.

Ownership and Financing.—Most utility companies favor utility ownership of street-lighting equipment except in the case of ornamental systems. In marked contrast to this practice one large utility company encourages the community it serves to own all distributing lines or cables, current transformers, posts, glassware and lamps for all street lighting, the utility supplying only the energy and operating and maintaining the system. One reason given for this practice is that it takes from the electric company the burden of constantly changing equipment to suit varying ideas of changing administrations.

Financing of ornamental street-lighting systems is either refused or avoided by most utility companies, chiefly because the types of standards, number of lamps per standard, location of lamps, etc., are subject to so many changes even during a short-term contract. This is largely due to the fickleness or variety of personal opinion regarding what type of system to install. Consequently, it is becoming quite general practice to ask the community to finance such installations either through ordinary sources of revenue or by assessment of property owners directly benefited. In such cases the utility contracts to furnish energy at a fixed rate and maintain the system at a nominal price. Only in exceptional cases will utilities consider financing ornamental systems, because it is felt that only a long-term contract will give adequate opportunity for retiring the


Relative Magnitude (Per Cent)
Add percentage indicated for price of energy, Dusk to dawn lighting
650%
465%
322%
Lamp renewals (decrease with reduction in burning)
96.8% 115% 138%
Cost of equipment and installing
Patrolling and renewing
Line repairs
Fixed charges in general line investment assuming 35 ft. poles
B B B B C B B C C
Support Bracket or Center Suspension
60 80 100 250 400 600 400 600
Candlepower
FIG.3

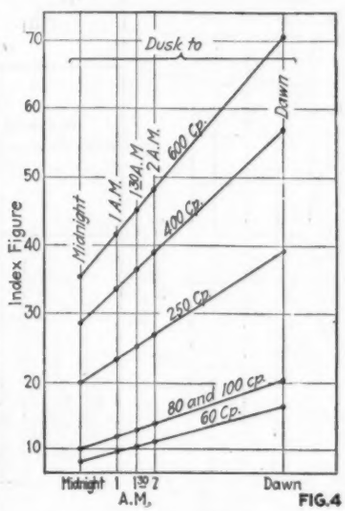


FIG.4

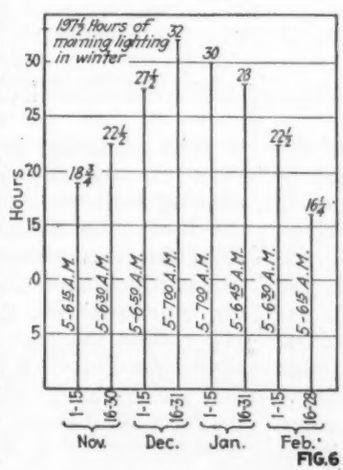


FIG.6

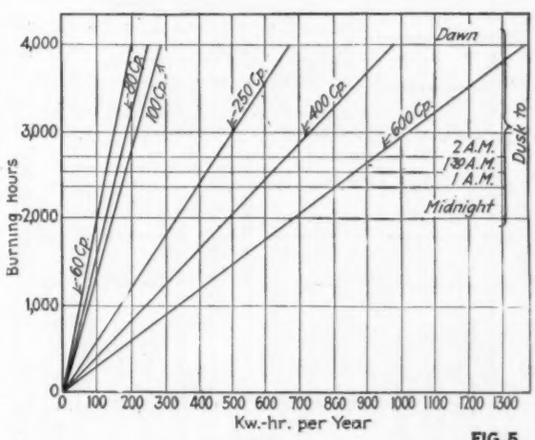
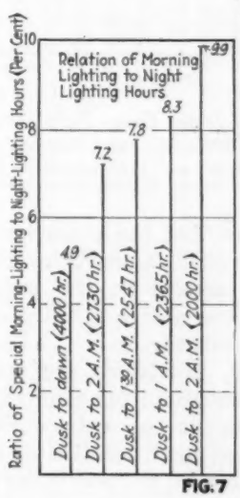


FIG.5


Relation of Morning Lighting to Night Lighting Hours
Ratio of Special Morning-Lighting to Night-Lighting Hours (Per Cent)
4.9
7.2
7.8
8.3
Dusk to dawn (4000 hr.)
Dusk to 2 A.M. (2730 hr.)
Dusk to 1 3/0 A.M. (2547 hr.)
Dusk to 1 A.M. (2365 hr.)
Dusk to 2 A.M. (2000 hr.)
FIG.7

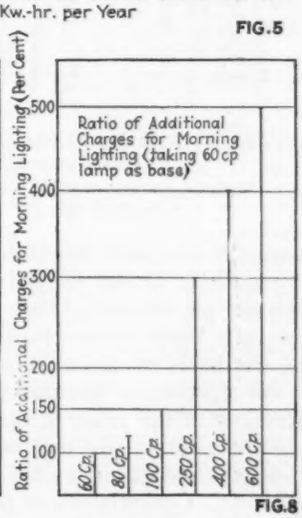

Ratio of Additional Charges for Morning Lighting (taking 60 cp lamp as base)
Ratio of Additional Charges for Morning Lighting (Per Cent)
60 Cp.
80 Cp.
100 Cp.
250 Cp.
400 Cp.
600 Cp.
FIG.8

Fig. 3—What Makes Up the Gross Cost of Operating Street Lamps

Based on dusk-to-dawn lighting with equipment shown in accompanying graph. Does not include damage claims, interest on deferred payments, extraordinary repairs, malicious damage, expense of changing locations, allowance for units over 400 ft. apart, or general expense which will amount to probably 10 per cent of total. The only items that change with number of burning hours are lamp renewals and energy consumption. For variations in these items see other graphs.

Fig. 4—Relative Renewal Costs of Different Size Lamps Burning for Different Periods

(Based on life of 1,500 hours.)

Fig. 5—Annual Kilowatt-Hours for Different Lamps and Periods of Burning

In calculating energy rates for these lamps it will be observed that all will earn a reduction on the maximum rate because of energy consumed. The amount of reduction depends on the size of the lamp and the number burned, ranging from 2 per cent for one to fifty 60-cp. lamps lighted from dusk to dawn to 30 per cent.

Figs. 6, 7 and 8—Magnitude of Morning Lighting Required in Winter, Relation to Regular Lighting and Ratio of Additional Charges Necessary

investment at a reasonable rate, and it is usually impossible to secure a long-term contract for ornamental lighting.

Burning Hours.—While an attempt is made by most utilities to obtain street-lighting contracts in which the lamps will be lighted from dusk to dawn, the rates are usually specified for different periods of burning, such as dusk to 2 a.m., 1:30 a.m., 1 a.m., 12 p.m., 11 p.m. or the like.

Rates.—Rates are drawn up in such a variety of ways that it is almost impossible to generalize. In all the cases studied they are offered on the per-lamp-per-year basis, taking into account hours of burning, fixed charges, interest, depreciation, insurance and taxes on investment in plant and line reserve. Where the rates for various classes of service are filed with the state commission, contracts are greatly simplified by merely referring to the rates on file, appending only those which are applicable to the case in hand. In all cases that have come to the attention of the writer the rates include compensation for breakage and replacements necessary during the life of the contract. In one case the company stipulates that the execution of the contract is based on the utility's exclusive right to render all street-lighting service in the community served. Some companies even give a detailed analysis of the basis of the price charged.

As previously mentioned, provisions are made for changes in the rates to compensate for changes in the cost of operation, lighting during extra-dark days, outages, and changes of size, kind, location or number of units. Comparisons of some of the provisions follow:

Minimum Bill or Load.—In at least four out of seven cases studied the utility stipulates that the minimum load shall not be less than a certain amount, there being no uniformity between systems regarding the relation of the minimum bill or load to the original installation. In one case the minimum load can never be less than that corresponding to the original installation and all additions made during the life of the contract.

Change in Cost of Operation.—When provision is made in contracts for a change in the cost of operation, it is usually the practice to stipulate that the rates shall be those authorized by the commission and revised from time to time subject to its approval. In one company's contract, however, the basis for adjustment is given in the contract, the rates being based on a certain price of coal, labor expense per man-hour and investment per lamp. The basic energy rate is so much per kilowatt-hour plus the coal and labor factors for different-sized lighting units. For each one-cent variation above or below these basic factors the rates per lamp are increased or decreased by the coal or labor factors which are listed in the contract. The actual average cost of coal and labor is submitted to the community served after the end of each year of service.

Extra Lighting.—Very few contracts specifically state what the charge will be for lighting on extra-dark days or during the winter mornings, although one company specifically states that the charge for such lighting will be on the same basis as the regular lighting period. On the other hand, another company gives a list of additional charges applicable to different sizes of lamps for extra lighting during the winter months.

Outages.—Considerable difference of opinion seems to exist regarding the conditions under which deductions for outages will be allowed, two companies allowing deductions for outages continuing more than one hour after notification, and two other companies for outages continuing forty-eight hours. The companies which allow deductions for lamps out more than one hour credit the community on an hourly rate basis (figured on the annual rate). One of the companies allowing a deduction after forty-eight hours stipulates that the deduction will not commence until the end of the forty-eight hours, while the other allows a deduction from the time of the notification if the outage continues forty-eight hours. In most cases the utilities require that the communities served report outages either through their police department or otherwise, although other companies state that they will inspect every lamp every night.

Changing Location.—All except one utility require that the community served pay for relocating any unit. The one exception says that the relocation will be made at the utility's expense, but under the condition that no

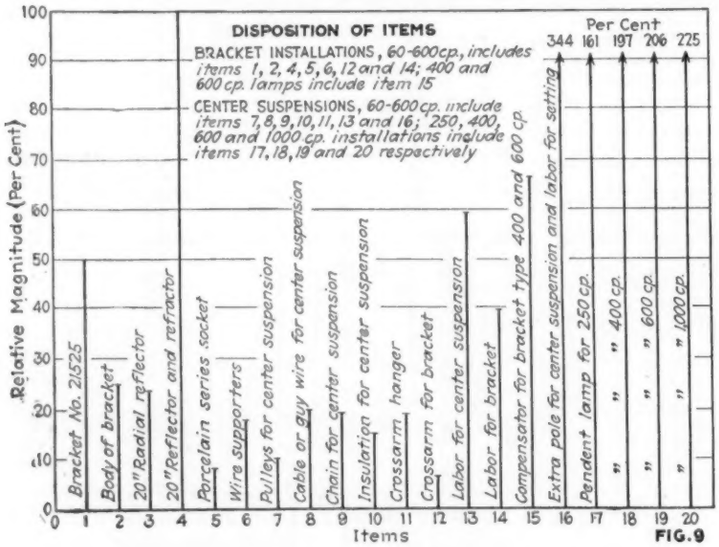

DISPOSITION OF ITEMS
BRACKET INSTALLATIONS, 60-600cp., includes items 1, 2, 4, 5, 6, 12 and 14; 400 and 600 cp. lamps include item 15
CENTER SUSPENSIONS, 60-600cp. include items 7, 8, 9, 10, 11, 13 and 16; 250, 400, 600 and 1000 cp. installations include items 17, 18, 19 and 20 respectively
Per Cent
344 161 197 206 225
Relative Magnitude (Per Cent)
Items
Bracket No. 21525
Body of bracket
20" Radial reflector
20" Reflector and refractor
Porcelain series socket
Wire supporters
Pulleys for center suspension
Cable or guy wire for center suspension
Chain for center suspension
Insulation for center suspension
Crossarm hanger
Crossarm for bracket
Labor for center suspension
Labor for bracket
Compensator for bracket type 400 and 600 cp.
Extra pole for center suspension and labor for setting
Pendent lamp for 250 cp.
" " 400 cp.
" " 600 cp.
" " 1000 cp.
FIG. 9

Fig. 9—Relative Prices of Items Going Into Street-Lighting Installations Made by One Company

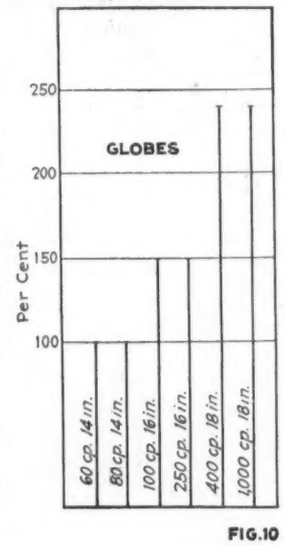


FIG. 10

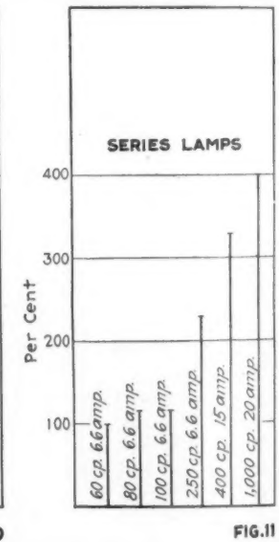


FIG. 11

Figs. 10 and 11—Comparative Costs of Globes and Series Gas-Filled Lamps

Figs. 10 and 11—Cost of globes has been increased 10 per cent to cover storeroom charges. Life is estimated at seven years. Cost of lamps is based on standard-package prices and is increased 10 per cent for handling and breakage.

unit will be changed in location unless it has been installed in its previous location at least six months, and provided the change in location does not require an extension of more than 400 ft. Sometimes the community served is charged a flat rate for relocating units, and in other cases it is charged with the actual cost to the utility.

Changing Size or Kind of Units.—As a general rule, no charge is made for changing the size of lamps used, but naturally the rate per lamp per year is changed accordingly. Where a totally new unit, including support, is substituted for an old one, the community served is required to pay for it. One company allows the community served a reduction in rates where a marked development in lamps or other equipment permits more efficient utilization of energy.

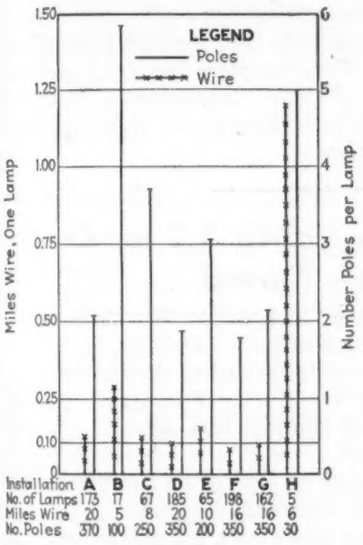
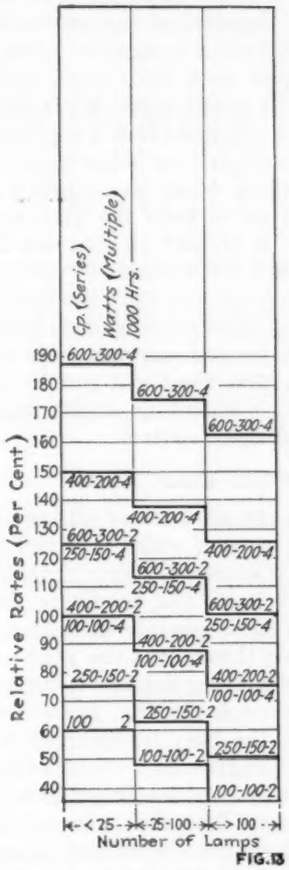


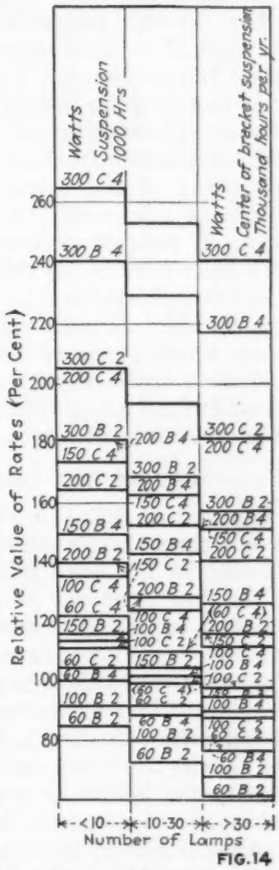
Fig. 12—Great Variations Exist Between Installations in Miles of Wire and Number of Poles per Lamp Installed

Changing Number of Lamps.—In the uniform contracts offered by some companies to every community on their systems the rates which are offered for different sizes of lamps and certain definite equipment, methods of mounting and burning hours are applicable to all lamps which may be installed during the period of the contract. Usually, however, there is a stipulation that additional lamps will not require more than 400-ft. extensions of overhead system per lamp, although one company allows 650-ft. extensions per lamp provided the new lamps are added during the first four years of the contract. The limitation made by one company on underground services is 250 ft. per lamp. To assure the retirement of investment in additional lamps installed during the life of the contract, one company requires that that part of the investment which will not be amortized by rates under the contract, owing to adding or discontinuing lamps, shall be returned to the utility by the community served. This is made definite in the contract by listing what the unamortized investment will be under different conditions.

Specific Details on Extensions

This same company requires an additional charge for additional lamps of so many cents for service extensions in excess of 400 ft. and stipulates that no excavation for underground services shall be required during December, January, February and March. The other companies which limit the extensions per lamp to 400 ft. also require the communities served to pay for the additional expense of the extension. One company which makes no provision for covering the unamortized investment in additional lamps takes care of the situation in part by prohibiting the installation of new lamps within twenty-four months of the expiration of the contract unless the municipality is willing to bear the expense. In such cases, if the contract is renewed, the company will refund to the municipality the cost of the new lamps. Still another company will install additional lamps up to the last year of the contract, provided that the cost of extending the service and installing the new units shall not exceed three times the annual revenue obtainable from the lamp. Investments for new equipment which cannot be amortized under the contract are also handled by requiring the municipality to contribute toward the cost of the installation an amount equal to the investment which will not be amortized. In the case of one installation where special station equipment had to be employed in units which were capable of serving ten lamps the number of lamps which could be installed during the life of the contract was limited to some multiple of this unit of ten lamps.





Figs. 13 and 14—Comparison of Rates Offered by One Company for Boulevard and Multiple-Lamp Overhead-Service Street Lighting

Both sets of rates are figured on a five-year contract. The boulevard rates are based on the consumer furnishing posts, globes and lamps. The consumer has the option of paying an additional 10 cents per year per foot of underground cable between posts or furnishing and installing the foundations and cables between posts. In making the additional charge the cable inside the posts is not included in computations. The utility furnishes and installs the foundations and cables, except under the conditions mentioned above, and supplies energy. The rate per year for less than twenty-five 100-watt lamps on ornamental posts lighted 4,000 hours a year is slightly less than the rate for the first 100 60-cp. series bracket-supported lamps served from an overhead system and lighted 4,000 hours a year. The rates for the first ten multiple-bracket-supported lamps served from overhead system and lighted 4,000 hours a year is approximately the same as for the first 100 60-cp. series bracket-supported lamps burning the same period.

Service.—What constitutes the service which shall be rendered by the utility company is covered in some contracts by a general statement saying that the company will maintain and operate the system in such a way that the original purpose will be served and that

reasonable diligence will be exercised to prevent outages. Other contracts may go into more detail, explaining the extent and degree of this service, but these details are usually only given in contracts with populous cities where the investment involved and the amount of money which must be paid yearly are relatively large items. For example, the service may be described to include all energy, labor, materials, supply and attendance required to operate the system properly and the prompt renewal of all burnt-out, defective or broken equipment as well as maintenance and cleanliness. In some cases the utility requires the community served, either through its police department or otherwise, to report all outages, although other companies agree to patrol the system and inspect each lamp every night or at some regular period. A credit allowance is made by only one company among those studied for permitting illumination from any unit to drop below a certain percentage of the illumination when new, owing to failure to renew old lamps or to keep the glassware clean. If reduced efficiency is allowed to continue for more than seventy-two hours, a reduction of 50 per cent in the rate charged per lamp is allowed until the trouble is corrected. Occasionally a stipulation is included to insure maintenance of voltage and current. Several companies specifically state that they will not be responsible for damage or outages caused by storms, mobs, riots or other causes beyond their control.

PAY ON "PER LAMP PER YEAR" BASIS

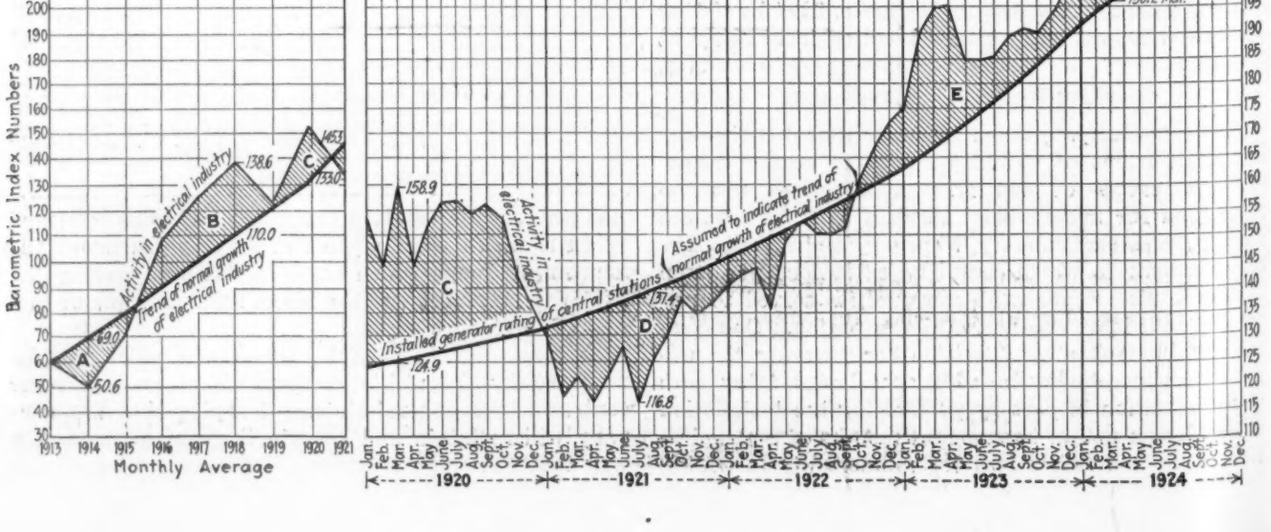
Payment of Bills.—A variety of ways of billing the street-lighting service exist, some of which involve long calculations, but there is a tendency to favor charging on the "per lamp per year" basis and requiring that payments be made in twelve equal monthly installments to produce a uniform revenue throughout the year and eliminate complications in computing the actual number of hours service is rendered each month. Some companies make adjustments in the bills for outages and new lamps installed or discontinued, while others simplify the billing by crediting or debiting the community served for such items. The time allowed for payment of bills after they have been submitted ranges up to forty-five days, although fifteen days is the preferred limit. Most companies require that any unpaid bills shall bear 6 per cent interest.

Miscellaneous.—Owing to the difficulties mentioned at the outset of the article, some companies are stipulating in their contracts that the community served shall vote an appropriation of money at the beginning of each year sufficient to cover the lighting expense for the coming year, while one company follows the opposite line of attack by limiting the number of street lights which shall be burned to an amount that can be covered by the appropriation that year. Where easements across private property are needed for service lines, municipalities are usually required by contract to obtain these easements. Some companies also endeavor to reduce breakages by requiring the community served to pass ordinances and enforce them for the prevention of malicious damage. One company has incorporated a rather unusual but desirable requirement that all equipment required for providing street lighting shall be exempt from taxation.

March Business Activity 3.7 per Cent Above Normal

FIGURES on which the "ELECTRICAL WORLD Barometer of Business Conditions in the Electrical Industry" are based indicate that activity within the industry in March was slightly less than during February. All the basic industries showed slightly less activity during March than in February.

A decrease of five-tenths of a point on the barometer scale as compared with February is shown. During this interval the industry has grown 2.4 points, leaving a net decrease in activities of 2.9 points in the barometer scale as compared with February. The electrical industry as a whole was operating in March at 3.7 points or per cent above what would have been the point of seasonal demand if growth in the industry had been normal. In February (revised) it was operating at 6.6 points or per cent above the point of normal demand. Incomplete returns indicate that the electric light and power branch of the industry was operating at 7.5 per cent above normal during March.



View of Residential District in Spokane Showing Types of Homes Where Electric Ranges Are Installed

How Shall the Electric Range Be Sold, Installed and Served?

FORWARD-LOOKING central-station executives have for a number of years realized that the electric range possesses great potential possibilities for increasing the residential load. Many have gone ahead and developed this business, believing that anything that tended to increase the use of electricity in the home would, in the final analysis, work out to the benefit of both the customer and the company. They have, however, had to solve many perplexing problems concerning rates and distribution capacity, in the manner most expedient as they arose. On the other hand, there are many central-station men who, because of the unknown factors, have held off and to some extent discouraged the installation of electric ranges on the lines of their companies. This situation is due entirely to the lack of definite information concerning the characteristics of the electric range load and the cost of serving it.

In the electric range survey which the range committee of the National Electric Light Association has undertaken at Spokane, Wash., a practical method has been devised for obtaining all of the essential information concerning energy consumption, kilowatt demand, load factor, diversity factor, demand factor, etc. With these data at hand it will then be possible to analyze the electric range load for the purpose of determining what effect its addition to a central-station system will have on ultimate capital investment and what rate for this service will be compensatory as the load grows. It is of first importance that the central-station company should be able to strike a balance between the growing public desire to cook electrically and the central-station company's right to supply its service at a commensurate profit.

IN SPOKANE, Wash., the range committee of the National Electric Light Association has selected a typical residential district for an intensive survey of the different factors involved in serving the range load. This district embraces 314 customers, of whom 159 use electric ranges. The plans of the committee contemplate the most complete and practical investigation of the characteristics of the electric range load ever undertaken in the electrical industry. While a report of the progress made thus far will be presented in detail at the Atlantic City convention, the purpose of the survey is of such vital importance to central-station executives, engineers and commercial men that all should give it serious consideration. The plan as mapped out is of particular value in that four alternative methods have been set up whereby the problems of installation, service, maintenance and sale of electric ranges can be intelligently studied.

The actual work of collecting the data, which has already been started in Spokane, is the crystallization of the efforts of many commercial men and the direct result of the co-operation of the Commercial Section of the Northwest Electric Light & Power Association with the range committee of the National Association. For some years central-station men have been endeavoring to obtain by individual effort more definite information concerning the electric range load. In Oregon, Washington, Idaho, Utah and Montana there are in service at this time approximately forty thousand electric ranges. Several of the utility companies have considerably more than five thousand ranges on their respective systems and the number is growing rapidly. There are some small towns in which there is a range in every other residence. So, after careful consideration of this field with the view of selecting the most representative average section in which to conduct a field survey, the residential district in Spokane has been chosen for the first intensive study. After this investigation is well under way it is planned to make further studies of conditions in high-class residential and industrial sections as well as rural territory.

How well the Spokane district is suited for such a study may be seen by the accompanying map, showing the location of residence services in the area which is supplied by one of the lighting feeders of the Washington Water Power Company. In this section there are 314 residential customers, and 159 of them, well distributed throughout the area, are using electric ranges. There are also 149 electric water heaters in use. The accompanying view of one of the residental streets shows the type of residences served.

The range committee has already sent out a questionnaire to each of the residential customers in the district from which complete information on the total connected appliance and lighting load of each residence has been compiled. A summary of this information is given in the accompanying table.

With these preliminary arrangements completed, the committee is in a position to go ahead and obtain accurate information on energy consumed, demand, demand factor and diversity factor of the range load, and also on what investment in the way of additional plant,

transmission and distribution systems is necessary when the load reaches different saturation points, such as one range to every ten customers, one range to every four customers, one range to every two customers and so on. The cost of getting such data in really reliable form will, of course, be considerable, and the committee has outlined four definite methods, varying in cost, which will be submitted to the executive committee of the national association with the request that it approve and make available the funds necessary to carry out the survey under the methods that will develop the greatest amount of useful data.

FOUR ALTERNATIVE METHODS OF MAKING SURVEY

1. *Approximate Method.*—This provides for a comparatively simple study of a large number of range customers. Graphic demand meters or wattmeters, to be installed at a substation and all transformer locations, supplemented with readings of the customers' meters over a period of one week, will give data from which approximate information can be obtained. The cost of this and the three other methods is estimated on the basis of the feeder shown on the map. The installation and expense, freight and traveling expenses are figured on the basis of twenty set-ups. Salaries for engineer and assistant cover a period of one year.

Twenty Westinghouse type RA demand meters	$2,400
Forty current transformers	1,000
Twenty cabinets equipped for pole mounting	200
Installation expense	4,000
Freight and traveling expense	2,000
Engineer and assistant	5,400
Total	$15,000
Less salvage on meters which it is proposed the member companies take off committee's hands	2,000
Net cost	$13,000

2. *Duplicate Secondary Bus Method.*—This provides for the installation of a duplicate circuit on each transformer secondary where survey is to be made. Recording demand meters are to be placed on this bus at the transformer and data obtained similar to those with the approximate method. Each range customer will be provided with a duplicate service loop since the lighting and range services are on the same set of service wires. The cost is as follows:

Twenty Westinghouse type RA demand meters	2,400
Forty current transformers	1,000
Twenty cabinets equipped for pole mounting	200
55,000 lb. copper wire, five set-ups	8,000
Miscellaneous material, set-ups	500
Installation expense, meters	4,000
Installation expense, wires	1,000
Freight and traveling expense	2,000
Engineer and assistant	5,400
Total	$24,500
Less salvage on meters	4,500
Net cost	$20,000

3. *Distant-Dial Method.*—This provides for a standard Sangamo watt-hour meter equipped with a special contact-making device in the register which by sending impulses over a low-voltage pressure circuit will register the summation readings of a group of ten watt-hour meters on one meter dial installed at a distance. By equipping this distant dial with a standard General Electric printometer and plotting the differences indicated by this printometer a load curve can be obtained which would be a curve of the aggregate demand of the group of ten installations. By the use of a Warren motor drive it wuold be possible to syn-

Map of Range Survey District in Spokane in Which There Are 314 Residential Customers, 159 Using Electric Ranges

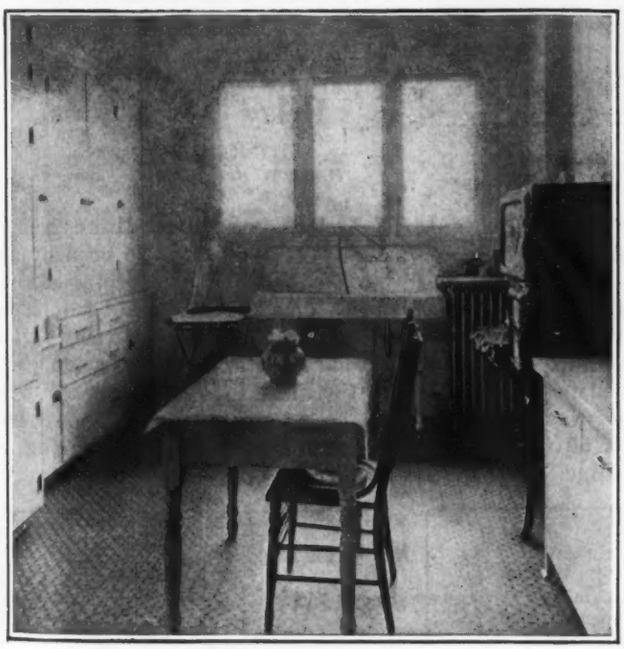
chronize the operations of any number of different printometers so that simultaneous records could be obtained on any number of groups of ten installations actuated by the distant-dial mehod, and thereby a load curve would be obtained showing the aggregate demand of any number of installations. Under this method the cost will be:

150 15-amp., three-wire Sangamo watt-hour meters equipped with contact-making devices and installed on range circuits	$3,250
Fifteen G. E. printometers with Warren motor drive and contact devices, installed	2,625
Fifteen Sangamo distant dials, installed	400
One 1-hp. a.c.-d.c. motor-generator set or storage battery for energizing control circuit	150
150,000 ft. of telephone, duplex-pair control circuit, installed, 5 set-ups	3,000
150 homes wired in with standard telephone wiring to range meter, five set-ups	6,000
Miscellaneous installation expense	4,875
Freight and traveling expense	2,000
Engineer and assistant	5,400
Total	$27,700
Less salvage on meters	3,700
Net cost	$24,000

4. *Individual Printometer Method.*—This provides for the installation of a printometer on each range circuit. Each printometer is to be equipped with Warren motor drive so that it is possible to synchronize the operation of all of them. A watt-hour meter of standard type on which is mounted a contact device for operating the printometer will be installed at each range service.

150 G. E. printometers with Warren motor drive	$24,915
150 watt-hour meters with contact device	2,585
Installation expense	5,000
Freight and traveling expense	2,000
Engineer and assistant	5,400
Total	$39,900
Less salvage on meters	$12,400
Net cost	$27,500

Of the various methods, the first and second represent the smallest expenditures, but the results obtained at best would be only approximations, and no way is provided to separate the lighting and range loads. On the other hand, the third or the fourth method will give accurate and dependable results based entirely upon recorded data and not involving any assumptions as to important but unknown factors. The committee has



Typical Electric Kitchen

therefore wisely recommended that a combination of the distant-dial and individual printometer method be adopted.

LACK OF DEFINITE DATA

At the present time no utility company is able to state definitely whether the electric range increases the system peak 500 watts, 1 kw. or 3 kw., and no central station is yet able to forecast what capital investment will have to be made to take care of the range load in future years. All data gathered so far depend to some measure upon approximation, and until accurate data are secured a sound range policy cannot be set down. From the experience of the companies in the Northwest it is only a question of time before electric ranges will be generally used throughout the country, and it is well-nigh imperative that the fundamental facts be ascertained on which to predicate remunerative rates and to plan distribution systems suitable for supplying both range and lighting loads in residential areas. If such

TOTAL CONNECTED LOAD OF 314 RESIDENTIAL CUSTOMERS IN SPOKANE RANGE SURVEY DISTRICT

Appliance	Total Number	Number per Consumer	Total Connected Load, Kw.	Connected Load per Consumer, Watts
Electric ranges	159	0.507	1,130.00	3,600
Water heaters	149	0.475	120.00	382
Flatirons	322	1.02	193.00	614
Vacuum cleaners	256	0.815	45.00	143
Curiing irons	156	0.497	2.35	7.5
Washing machines	153	0.488	30.70	98
Toasters	171	0.545	85.50	272
Percolators	140	0.447	56.10	178
Waffle irons	92	0.294	55.00	175
Air heaters	73	0.233	44.00	140
Sewing machines	69	0.220	6.90	22
Grills	61	0.195	36.90	117
Heating pads	42	0.134	2.10	6.7
Hot plates	31	0.099	31.20	99
Vibrators	28	0.089	2.80	8.9
Chafing dishes	9	0.029	2.70	8.6
Ironing machines	6	0.019	9.00	28
Immersion heaters	7	0.022	3.50	11
Miscellaneous	22	0.070	5.75	18.3
Total	1,946	6.2	1,862.5	5,930
Total exclusive of ranges and water heaters	1,638	5.2	612.5	1,948
Lamp sockets	8,640	27.4	432.0	1,370
Grand total	.....	.....	2,294.5	7,300

	Total Number	Number per House
Rooms	2,440	7.75
Persons	1,210	3.86
Maids	75	.24

information is not developed, there is grave danger that the electric range load will be permited to grow haphazardly and get so far out of hand as to create a situation which from the standpoint of rates, distribution capacity, investment and so on will be similar to the question of power-factor regulation brought about by the enormous increase in induction-motor load during the last five years.

The range committee so far has gathered together much valuable information on the subject. It is, however, confronted by the fact that all available data are at best of fragmentary nature which cannot be combined or presented in a composite manner from which definite principles can be evolved. In starting the survey in Spokane due recognition has been taken of this lack of reliable information and a practical method is proposed for finding out many unknown facts.

Whether the individual central-station company has been actively engaged in building the electric range business or not, there is a very strong inclination on the part of many persons to cook electrically. It is more than mere curiosity, and when there is such a general demand the public will be served somehow. If ample provision is made so that this range survey may be carried through to completion, central-station companies will no longer be working in the dark as to the characteristics and requirements of the electric range, but will be able to plan for and take on this business in an intelligent manner.

Central Station and Industrial Practice

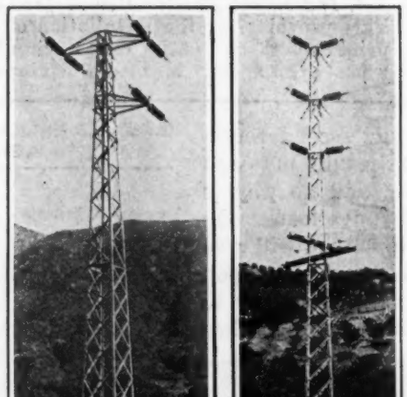
Installation, Operation, Maintenance, Test and Repair of Generation and Distribution Equipment, and Methods of Economically Utilizing Electric Service in Large Industrial Plants

Steel-Pole Transmission Line Construction

BY N. B. HINSON
System-Planning Engineer, Southern California Edison Company, Los Angeles, Cal.

THE growth and importance of the load in the town of Santa Barbara, Cal., demanded that a second transmission line be constructed to insure continuity of service after the closing down of a steam plant in the city which had been used for standby service. The existing transmission line operated by the Southern California Edison Company was erected some time ago along the ocean on one of the only two available highways. Owing to telephone leads and the impossibility of shutting down the existing line for reconstruction, it was necessary to select another route for the new line. The only other possible route for a part of the distance was along the side of the mountains. These mountains are covered with brush and subject to frequent fires, which made a wooden-pole line impossible.

The line as built consisted of steel poles carrying a single 60-kv. circuit, as shown in the accompanying illustrations. The poles have a 3-ft. base and are set in the dirt without concrete. Special bearing plates were used on the footings just below the ground line. On angle poles special channel iron was used on the bearing side only. The poles were shipped in sections to facilitate handling. The footings were installed and the rest of the pole was assembled on the ground and erected as a unit on the footings. It was necessary to build trails to most of the poles and a road in a few locations. The right-of-way had to be cleared of brush for 50 ft. on either side of its center line. The steel-pole line is 14 miles in length and consists of a single 60-kv. circuit of No. 2/0 bare stranded copper wire supported by five standard 10-in. suspension insulators per string. No overhead ground wire is used. The line contains 107 steel poles, forty-two of which are standard, fifty-two angle and eight special dead-end poles. The poles are 51.5 ft. in length with 36-in. base and 9-in. and 12-in. tops. Some are provided with 5-ft., 10-ft. or 15-ft. extensions.



THIS 66-KV. STEEL-TOWER LINE COST $7,935 PER MILE TO ERECT

COST OF THE COMPLETED 66-KV. LINE

Steel poles, complete with steel arms	$21,220.00
Miscellaneous material used in tower erection	5,343.00
Suspension insulator, clamps, etc.	7,916.00
No. 2/0 copper-base stranded wire	15,460.00
Miscellaneous material used in line installation	2,249.00
Right-of-way expense	7,200.00
Roads and trails	4,549.00
Supply and transportation expense	6,307.00
Labor on pole foundations	5,733.00
Labor erecting steel poles	9,864.00
Labor hanging insulators	1,188.00
Labor stringing wire	4,087.00
Hauling	2,010.00
Overhead and engineering	17,969.00
Total cost	$111,095.00
Average cost per mile	7,935.00

Method of Simplifying Relay Connections

BY RALPH BROWN
Great Western Power Company, Caribou, Cal.

UNDER special conditions relays may be attached to or near apparatus that is to be protected, but in all such cases a method must be chosen that will prevent relay action because of shocks or vibration. The best location for relays appears to be on the main control switchboard, but in some cases so much wiring is required to accomplish this that re-

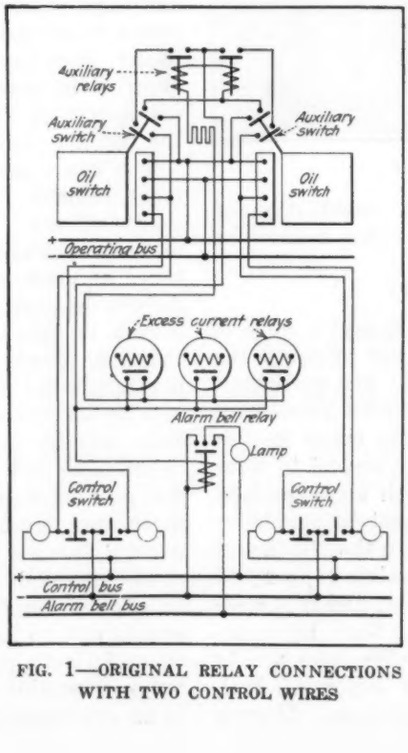


FIG. 1—ORIGINAL RELAY CONNECTIONS WITH TWO CONTROL WIRES

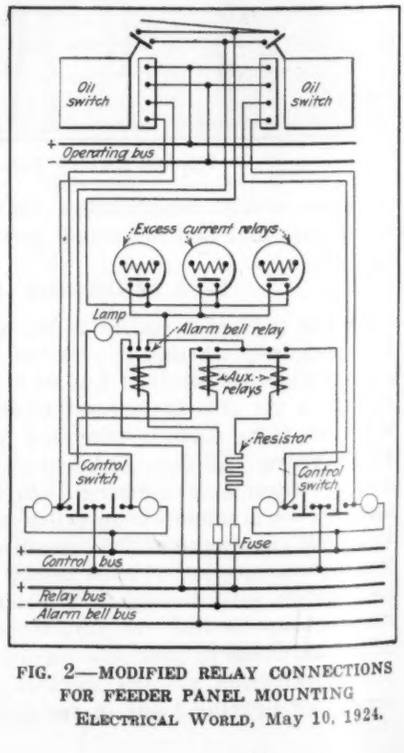


FIG. 2—MODIFIED RELAY CONNECTIONS FOR FEEDER PANEL MOUNTING

lays are placed at such points as will reduce to the minimum the number of wires and their lengths.

Apparently in order to limit the number of additional control wires to two in connection with the excess-current relays used to protect feeders radiating from a large substation, provided with a double bus, connections were made as shown in Fig. 1. Upon closure of the contacts in any of the three excess-current relays the windings of the two auxiliary relays, which were placed on top of the oil switch cells (see Fig. 3), became energized, provided the oil switches or either of them were closed. Closure of the auxiliary relay contacts applied current to the trip coils, causing the feeder switches to open. Opening of the oil switches caused the circuit to each pair of auxiliary relay contacts, and to the auxiliary relay windings, to be opened by the auxiliary switches shown. The auxiliary relays are required normally to separate the opening wires for each pair of feeder switches as well as to carry the current of 15 amp. drawn by each trip coil.

The principal objection to the arrangement shown in Fig. 1 was that, owing to their exposed position, the auxiliary relay contacts were jarred closed a few times by maintenance men accidentally striking the supporting frame, this resulting in the opening of the feeder switch.

Seeking a method of eliminating this serious fault without installing additional wiring, a study was made of the connections, and it was found that the auxiliary switches in series with the auxiliary relay contacts were unnecessary, for the trip-coil current was actually interrupted by a contact finger forming part of the oil-switch mechanism. The auxiliary relay contacts were not heavy enough to break the tripping current, hence the apparent need of the auxiliary switches. Further study indicated that the current required to energize the auxiliary relay windings was so small that it could safely be interrupted at the excess-current relay contacts, and therefore it was unnecessary to connect an auxiliary switch in series with the auxiliary relay windings. It also appeared that one multi-contact relay would be more suitable than the two independent auxiliary relays in use.

As a result of the facts disclosed, connections were modified to conform to Fig. 2. Each pair of auxiliary relays was moved to a protected position on the corresponding feeder panel, only a few feet of wire then being required to connect to the opening wires at the control switches. Use of the original two wires and of one pair of auxiliary switches was retained to prevent any current being broken by the excess-current relay contacts. A relay bus was installed for the sole purpose of delivering energy for the operation of all relays, relay indicating lamp and alarm bells.

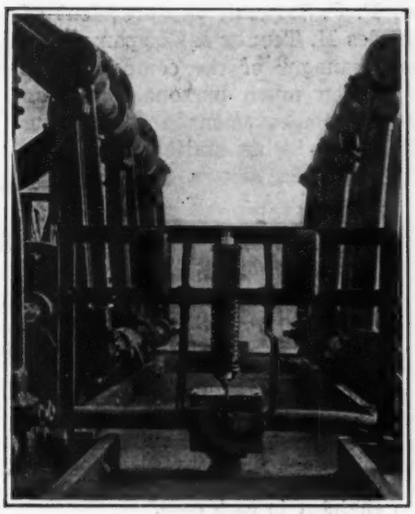


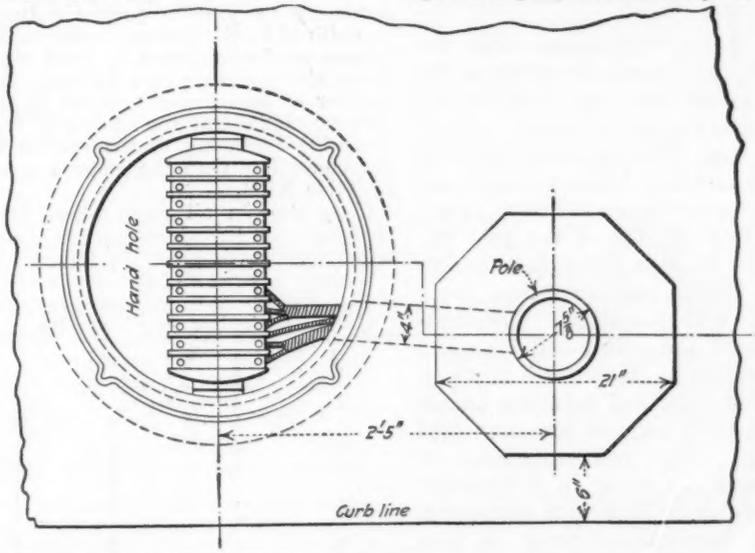
FIG. 3—AUXILIARY RELAYS MOUNTED ON TOP OF SWITCH CELLS

Making Steam Strainer Easily Accessible

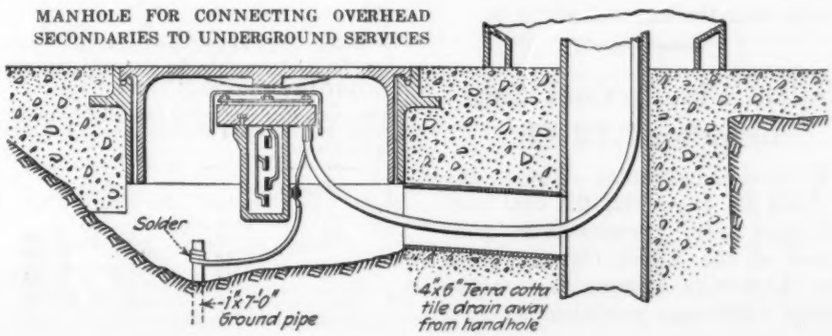
OCCASIONALLY, but not frequently, the strainer in the steam line to the turbine throttle will become sufficiently clogged to increase the pressure drop and thereby affect the turbine performance. Or, as happened in one case, the screen through combined vibration and erosion or corrosion will break and require replacement. When the screen inclosure is entirely surrounded with lagging like a pipe, valve or joint, removal or inspection of the screen requires the lagging to be removed. This consumes time, requires cutting of the lagging and replacement. To eliminate these objections and still make the screens accessible, the Memphis Power & Light Company applies the lagging to the screen-chamber lid and remainder of the exterior separately. As a result the lid may be removed merely by unbolting it.

Unusual Distribution Plan for City Streets

A DEPARTURE in semi-underground construction has been developed by the Carolina Power & Light Company for the city of Ra-



MANHOLE FOR CONNECTING OVERHEAD SECONDARIES TO UNDERGROUND SERVICES



leigh, N. C. On the main street secondary power and light leads are carried on iron standards which serve also for street lights and trolley poles. The transformers and primaries are installed on side streets and the secondary leads only are carried on the standards, as shown herewith. These leads are

BUILDING SERVICE BUSES RUN THROUGH POLE TO MANHOLE

fastened by attachments near the top of the standards with power leads on one side, light leads on the other and the street-lighting circuit on the top. Through solderless connectors and lead cables the light and power service buses to buildings are taken into the top of the pole and down to its base through a conduit into a special manhole whose cover is flush with the street. The manhole is of the diving-bell type and has a series of small buses to which incoming leads and outgoing underground local services are connected by lugs. The interconnections on the buses are made in a compartment which is filled with compound, and a hard-rubber cover is then placed over the exposed surfaces.

Salem Plant's Coal Consumption 1.72 Lb.

IN THE ELECTRICAL WORLD for April 26, page 832, the coal consumption per kilowatt-hour generated at the Salem (Mass.) Electric Lighting Company's station during 1923 was published as 1.93 lb. F. C. Sargent, vice-president of Charles H. Tenney & Company, Boston, manager of the company, who has given much personal attention to the improvement in operating efficiency of this station from year to year, states that the correct figure is approximately 1.72 lb., owing to the fact that the fuel is measured in short tons of 2,000 lb. each, instead of in the long tons used in the published computation.

Overhead Distribution Construction

Standardized Practice as Developed and Used by the
WEST PENN POWER COMPANY, PITTSBURGH

Services from Secondaries

General.—Services of less than 500 volts shall be installed according to the following specifications, while services above 500 volts shall be made according to special plans furnished by distribution engineer in each case.

Material.—All overhead services shall be made with standard triple-braided weatherproof copper wire, not smaller than No. 8 B. & S. gage. Underground services shall be of standard double-braid, rubber-covered copper wire placed in approved conduit, provided with condulet fittings and otherwise so installed as to prevent water from entering the conduit.

The standard size of service wires for lighting and appliance loads shall be as follows: One to five circuits of 660 watts or less, No. 8, two-wire; six to nine circuits of 660 watts or less, No. 8, three-wire; ten to thirteen circuits of 660 watts each or less, No. 6, three-wire.

The size of service wires for power loads shall be determined from Table XVI, except where larger services are necessary to provide proper voltage as outlined in the accompanying table. Larger conductors must be used than given above if necessary to make the number of horsepower capacity of the motor multiplied by the number of feet from the beginning of the service to the motor less than the amount given in Table XVII.

Supports.—In all cases where both power and lighting are supplied to separate meters at one location a separate service must be provided for each, even where both are supplied from the same transformer secondaries. Service wires at poles shall be attached to the secondary rack insulators and tapped to the secondary mains. Services of smaller than No. 0 wire shall be attached to buildings by means of standard house brackets, and services of No. 0 and larger wire shall be attached by standard pole racks, Fig. 57.

Brackets or racks shall be securely fastened to the building with suitable wooden screws at least 2 in. long. On brick walls they shall be attached by means of ¼-in. x 2½-in. Pierce expansion bolts or equivalent. On hollow-tile walls they shall be attached by means of ¼-in. x 3½-in. toggle bolts with full thread.

Ordinarily service wires shall be brought out of the building at such a point that only one house bracket is required. If for any reason this is not done, brackets shall be placed not more than 9 ft. apart. Where the position of a building is such that the service outlet cannot be located at a point which may be reached by a single span

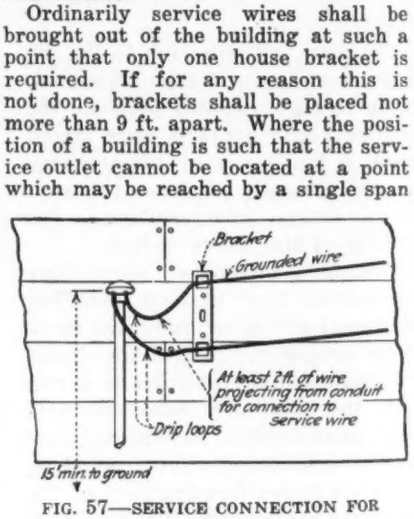

Bracket
Grounded wire
At least 2 ft. of wire projecting from conduit for connection to service wire
Drip loops
15' min. to ground

FIG. 57—SERVICE CONNECTION FOR CONSUMERS

of 125 ft. or less from the pole line, or where the outlets of a low structure must be brought out less than 15 ft. above the ground, some form of intermediate support of suitable strength and height must be provided. When the intermediate support is a pole placed in the ground, it must not be less than 5 in. in top diameter and 19 ft. long, with 4 ft. set in the ground.

When the support consists of a riser attached to the building to which the service is to be run, the riser must be at least 4 in. x 4 in., fastened to the building by bolts. The pole or timber mentioned above shall be of clear, sound, straight-grained fir, pine or cypress wood. Adjacent buildings shall never be used to support the service wires without written permission of the owners.

TABLE XVI—SIZE OF SERVICE WIRES FOR POWER LOADS

Motor Rating, Hp.	Single-Phase 230 Volts	Three-Phase 230 Volts	Three-Phase 460 Volts
¾	8	..	..
1	8	..	..
2	8	..	..
3	6	..	..
5	6	8	8
7½	4	8	8
10	2	8	8
15	2	8	8
25	..	6	8
50	..	2	6
75	..	0	4
100	..	4/0	2
150	..	..	0

TABLE XVII—METHOD OF DETERMINING SECONDARY SERVICES FOR MOTORS

Horsepower capacity of motor multiplied by number of feet from beginning of service must fall within the figures given.

Wire Size	Single-Phase 115 Volts	Single-Phase 230 Volts	Three-Phase 230 Volts	Three-Phase 460 Volts
8	293	1,185	.....	.....
6	575	2,340	6,920	27,700
4	...	3,565	10,320	41,300
2	...	5,320	14,800	59,100
0	...	7,830	20,650	81,300
4/0	...	13,830	31,700	126,700

Central Station Business

Advertising, Selling and Service Methods
Commercial Organization and Management, Customer and Trade Relations, Public and Financial Policies, and Reports of Company Plans and Experiences

Making Industrial Electric Heating Pay

An Analysis of the Growth of Business, Value of Load as Revenue Producer and Field for Future Development

By Wirt S. Scott
Manager Industrial Heating Section
Westinghouse Electric & Manufacturing Company

FOR industrial electric heating to be a profitable, and therefore a successful, business, it must appeal to the user, to the central-station company and to the electrical manufacturer alike. To warrant any considerable time and attention being given to the development of this business and any large sums of money being expended, there must also be a sufficiently large field to justify the effort and expense of pioneer work. An analysis of these different factors and an appraisal of the present growth and value of the industrial electric heating load indicate almost unlimited future possibilities.

There is connected and in daily operation in the United States approximately 1,200,000 kw. of industrial heating. The growth has been steady, increasing by a substantial margin over the immediately preceding year, making due allowance for business depressions. During this period, very few electric installations returned to the former methods of heating, the figure being less than one-tenth of 1 per cent of those installed, which may be taken as a most positive indication that satisfaction has been given to the user and that electric heat is showing him a profit.

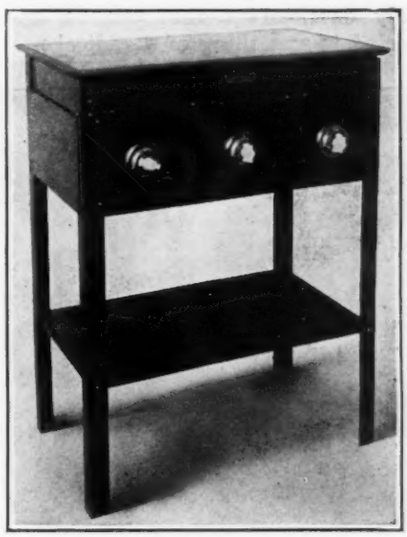
Data received from one central station serving energy for glue pots, solder pots, space heaters, bread-baking ovens, industrial ovens and heat-treating furnaces show an annual revenue per kilowatt demand approximately double that received from the motor load. Another comparison is the "profit and loss sheet" showing comparative values for 100 kw. connected of lighting, motor and industrial heating.

Central stations have recognized the desirability of the domestic heating load and are bending their efforts to get these appliances on their lines. As the domestic appliances make a profitable load, worthy of the amount of effort put into their sale, it may be permissible to accentuate the relative importance of industrial heating by showing a comparison of *energy consumption* and *dollar value* between several heating devices and an industrial space heater.

The comparison is made to show the value of this tremendous potential load to central stations.

Industrial electric heating in this country has been on a commercial scale for about eight or ten years. The development has been along substantially the same lines as that of any other large field, namely, the development of a large number of specialized pieces of apparatus to meet the varied conditions of application. There was no precedent to show the logical trend of development, and the only way experience could be gained was by having the actual experience of success or failure; hence, as was inevitable, a large number of different kinds of apparatus and different applications were made which should not have been made at that time.

After years of experience trained men, through the success or failure of installations, have accumulated a fund of information sufficient for them to predict in advance whether or not an application at this time can be classified as desirable or undesirable. With this knowledge and purpose, they are in a position to render a valuable service in promoting industrial electric heating by re-



ELECTRIC HOT TABLE FOR RESTAURANTS—3 TO 4.5 KW. DEMAND

COMPARATIVE ENERGY CONSUMED AND REVENUE BASED ON THE SAME VALUE OF APPARATUS

Appliance	Selling Price	Demand, Watts	Annual Consumption, Kw.-Hr.	Annual Revenue — At 10 Cents per Kw.-Hr.	Annual Revenue — At 3 Cents per Kw.-Hr.	Ratio of Energy Consumption and Earning Power Based on Same Selling Prices
1 flatiron	$7.50	500	60	$6.00	.....	Three industrial heaters consume sixty times as much energy and earn eighteen times the revenue of one flatiron
3 industrial heaters (500 watts per unit)	7.50	1,500	3,600	....	$108.00	
1 toaster	5.00	500	36	3.60	.....	Two industrial heaters consume sixty-six times as much energy and earn twenty times the revenue of one toaster
2 industrial heaters (500 watts per unit)	5.00	1,000	2,400	....	72.00	
1 sewing-machine motor	15.00	.50	15	1.50	.....	Six industrial heaters consume 480 times as much energy and earn 144 times the revenue of one sewing machine motor
6 industrial heaters (500 watts per unit)	15.00	3,000	7,200	....	216.00	
1 washing machine	150.00	250	30	3.00	.....	Sixty industrial heaters consume 2,400 times as much energy and earn 720 times the revenue of one washing machine.
60 industrial heaters (500 watts per unit)	150.00	30,000	72,000	....	2,160.00	

ducing to a minimum the number of possible unsuccessful applications.

This experience in the design and application of industrial heating apparatus has resulted in the development of apparatus that will fill a large percentage of the requirements, and in the accumulation of sufficient operating data to enable the operating costs and net results to be determined quite accurately.

There are two periods in building up any large field where a considerable amount of money must be expended in the development of apparatus. The first is in the early stages, during which there are no standards and each application is more or less special. The second stage is after the art has been perfected to a high degree, when the only development that can be expected is something of a radical nature in the way of a new invention, requiring probably an entirely new method. Industrial electric heating is in the intermediate class. At the present time there is a sufficient amount of equipment developed to serve the majority of applications. If this business is to be made a success, the development of apparatus will have to be stopped and more standard equipment used.

The electrical manufacturers and the central-station companies are co-operating in the promotion of industrial electric heating, which must be mutually beneficial in order to be pronounced a success. A reasonable amount of development work can be expected of the electrical manufacturing company, and a reasonable amount of investigation work can be expected of the central station. However, such a program cannot be carried out indefinitely with a new business as broad in scope as that of industrial electric heating. The question to be decided is, when shall the central stations and the electrical manufacturing companies cease developing and start selling?

The possibilities are so large that it is difficult to hazard a guess as to the extent of the field. Incomplete surveys made up to the present time in different territories show the available heating load to be from two and one-half to five times the available motor load.

Heat is used in some part of the process of every manufactured article. There is an application for electric heat in every factory. As previously noted, some of these applications at the present time may not be particularly desirable ones, but there will be found a sufficient number that are, and the power sales engineer, with proper training, will be in a position to judge this very quickly.

The industrial electric heating load on the line of the central-station companies of the United States in 1923, in round numbers, totaled one million kilowatts connected and earned a gross revenue of about forty million dollars. Considering the diversity factor, the revenue produced per kilowatt of demand on the central station plant from this class of load as a whole should not be less that $75. Miscellaneous small heating units, which, by the way, represent one-third of the total, show returns of approximately $100 per kilowatt demand per annum.

PROFIT AND LOSS SHEET, SHOWING COMPARATIVE VALUES OF 100-KW. CONNECTED LOAD

Investment:	Residence Lighting	Business Lighting	Street Lighting	Motor Load	Industrial Heating
Station	$4,625.00	$14,800.00	$23,604.00	$12,200.00	$15,000.00
Lines, transformers and services	3,500.00	16,000.00	36,936.00	3,000.00	3,000.00
Total	$8,125.00	$30,800.00	$60,540.00	$16,200.00	$18,000.00
Revenue	1,200.00	7,500.00	21,600.00	4,080.00	6,192.00
Expense:					
Production	$180.00	$1,248.00	$3,984.00	$1,161.60	$2,065.00
Distribution	140.00	640.00	6,516.00	112.00	120.00
Commercial	100.00	250.00	900.00	80.00	100.00
Taxes and general expense	120.00	768.00	1,552.00	306.40	495.00
Depreciation	406.25	1,540.00	4,692.00	800.00	900.00
Total	$946.25	$4,446.00	$17,644.00	$2,460.00	$3,680.00
Net profit	253.75	3,054.00	3,956.00	1,620.00	2,512.00
Per cent on investment	3.3	9.9	6.5	10	14

SMALL ELECTRIC HEAT APPLICATIONS. LEFT, 15.6-KW. MELTING POTS; CENTER, 320-WATT CHOCOLATE WARMERS; RIGHT, 1,250-WATT SOLDER POT

KILOWATTS CONNECTED, ANNUAL CONSUMPTION AND REVENUE OF INDUSTRIAL ELECTRIC HEATING ON CENTRAL-STATION LINES

Apparatus	Kw. Installed	Annual Consumption, Kw.-Hr.	Revenue Produced
Steel-melting furnaces	225,000	505,000,000	$6,200,000
Brass-melting furnaces	95,000	290,000,000	4,700,000
Heat-treating furnaces	85,000	220,000,000	3,900,000
Industrial ovens	200,000	380,000,000	6,500,000
Bread-baking and commercial cooking	100,000	109,000,000	2,700,000
Welding	55,000	25,000,000	880,000
Miscellaneous small units	325,000	590,000,000	14,800,000
Total	1,085,000	2,119,000,000	$39,680,000

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
from All Parts of the World

Photostat copies or English translations of complete articles will be furnished at cost upon request

Hydro-Electric Development and Steam Equipment

Water Power in Scandinavia. — F. JOHNSTONE-TAYLOR. — Hydro-electric stations of Norway and Sweden placed in operation during the past three or four years are briefly described. Among the stations are those at Vamma, Herlandsfossen, Raanaafoss and the Nore Falls in Norway, and at Forshuvudforsen, Finspongs and Untraverket in Sweden.—*Electrical Times (England)*, March 13, 1924.

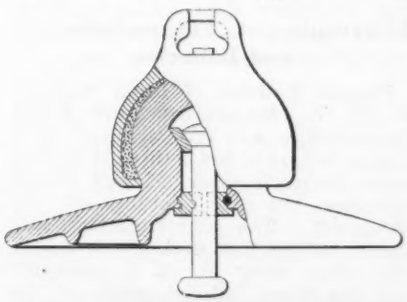
Musquash Hydro-Electric Development.—F. B. CASEY.—The Musquash development was the first undertaken by the New Brunwick (Canada) Electric Power Commission and embraces two branches of the Musquash River. The power is generated in one station situated in the channel of the east branch, where three turbo-generators develop 11,000 hp. for transmission to St. John and the surrounding district. —*Canadian Engineer*, April 8, 1924.

Refractories for Boiler Settings.—At a recent conference of the committee on refractories of the Federal Specifications Board the tentative specifications for boiler-setting refractories were revised to meet the suggestions submitted by the industry and by the various government departments. The specifications as revised are to be submitted to the Federal Specifications Board. At the conference it was further decided to take up the preparation of specifications for fireclay used as a mortar and for the so-called "plastic" refractories used in building rammed-up boiler linings.—*Technical News Bulletin No. 84 of the Bureau of Standards.*

Transmission, Substations and Distribution

Ventilation and Noise Control for Substation Machinery.—F. T. HAGUE.—It is possible to effect considerable control of the noise generated in substation machines by using an inclosure system primarily designed to control ventilation. By confining the noise generated within the machine to a definite inclosed circuit for the discharged ventilating air it is possible to lead most of the noise from the substation and discharge it at such a location and in such a direction as to cause minimum annoyance to those occupying adjacent property. Total and semi-inclosed machines and methods of inclosing existing machines are discussed.—*Electric Journal*, March, 1924.

Sphere-Head Chain-Type Insulator. —M. CAROLUS.—Differing from designs that contain within the hollow part of the sphere a number of loose pieces which have to be assembled and securely locked in place, this insulator requires only one annular ring in the head. The button-shaped type of the inserted bolt deforms this ring into conical shape, thus preventing the removal of the bolt from the insulator. The deformation is made in the factory on a special draw press and suitable temporary inserts. Near the lower edge of the porcelain part a round centering piece is sprung in a groove, which serves to insure a vertical position of the bolt. The upper retaining



INSULATOR WITH BUT ONE ANNULAR RING IN THE HEAD

member of the insulator is a metallic cap cemented to the head. The standard model breaks at the cap end under a pull of 8 tons. At 11 tons the upper part of the insulator fails, but in no case was it possible to pull the bolt out of the head.—*Elektrische Betrieb*, Feb. 24, 1924.

Generation, Control, Switching and Protection

Voltage Displacements on Grounding Transformers. — H. GRÜNHOLZ. — In connection with the capacity of networks the grounding transformer represents an oscillatory system with closed iron-core inductivity, permitting, with given external characteristics, several conditions of equilibrium. In his mathematical paper the author shows that in virtually all existing cases no dangerous voltage displacement can occur on account of the core saturation or, with transformers not magnetically saturated, on account of the watt component of the ground current. This fact, the author maintains, applies alike to neutral or phase-connected grounding coils. A very effective method is described to counteract the ground current losses and to reduce at the same time phase unbalance to a minimum by a combination of a so-called "negative booster transformer" and a grounding transformer connected in series to the Y-point of the system. By means of a chosen practical example the great saving of energy is shown.—*Elektrotechnik und Maschinenbau*, March 30, 1924.

High Pressure, Reheating and Regenerating for Steam Power Plants.—C. F. HIRSHFELD and F. O. ELLENWOOD.—The authors discuss the relative thermal and investment costs involved in a modern turbo-generator station, as determined by a consideration of steam pressures from 200 lb. per square inch to 1,200 lb. per square inch, temperatures of 700 deg. F., and 800 deg. F. and six different cycles of operation in which reheating and regenerating are involved in various degrees. The first part of the paper deals with information that may be gained from the study of ideal steam-power-plant cycles, and the second part gives the probable results from real plants operating on several cycles and at different pressures.—*Mechanical Engineering*, April, 1924.

Efficiency of Large Turbines.—C. SYLVESTER.—The author considers the effect of high pressure, superheat and vacuum on the efficiency of large turbines. He gives several illustrations of the variations that may be caused by changes in either of the three above factors. — *Electrical Times (England)*, March 20, 1924.

Treatment of Circuits Containing Iron-Core Reactances and Capacity.—L. FLEISCHMANN.—Circuits possessing variable self-induction and capacity are difficult to solve analytically, and as an alternative the author presents a graphical method of treatment. If properly used, it should prove a very useful tool to engineers who are confronted with these problems.—*General Electric Review*, April, 1924.

Units, Measurements and Instruments

Method of Measuring Time Intervals.—A. B. WOOD and J. M. FORD.—A description is given of an electrically controlled chronometer which is capable of directly indicating time intervals with an accuracy of one-thousandths of a second. The chronometer is driven by a powerful phonic motor controlled by a tunning fork of adjustable frequency. Methods of eliminating and compensating for errors are dealt with and accuracy tests are described. Chronometers of this type are used in the accurate measurement of time in physical investigations, motor-car speed events and electrical investigations involving measurements of quantity (current multiplied by time). The instruments are robust in design and permit of simple manipulation of all parts requiring adjustment. — *Journal of Scientific Instruments (England)*, March, 1924.

Relation Between the Tensile Strength and the Electrical Resistivity of Commercially Pure Copper.—W. E. ALKINS. —In connection with the drawing up of a revised specification for hard-drawn copper the author undertook a short series of experiments with the object of investigating the connection between the increase in resistivity of hard-drawn commercially pure copper and its tensile strength. The results of these experiments are given.—*Engineering (England)*, March 14, 1924.

Three-Phase Wattmeter Connections. —P. C. JONES.—The author points out that for several years much literature has appeared giving methods of checking the connections of three-phase wattmeters. Nearly all these articles point out the frequency with which misconnections occur and their diffi-

culty of detection. In the author's opinion, however, several serious errors have appeared and the information itself has in some cases been incorrect. He fills in this gap by treating the basic principles of the subject. —*Journal of A. I. E. E.*, April, 1924.

Illumination

Daylighting from Windows.—H. H. HIGBIE and G. W. YOUNGLOVE.—The authors present a considerable amount of experimental data covering various points of practical importance and great interest with respect to daylighting of interiors, upon which actual and detailed quantitative information appears too meager. The data presented cover actual utilization coefficients for typical daylight illuminations, together with curves and coefficients representing distribution of the daylight under a variety of conditions, the relative effect and efficiency of light from various portions of the window area, the effect of various methods of controlling the light from windows by means of shades and blinds and the effect of accumulations of dirt on windows.—*Journal of I. E. S.*, March, 1924.

Motors and Control

Steel Plant of the National Enameling & Stamping Company. — G. L. LACHER.—The latest additions to the capacity of the company's main steel works at Granite City, Ill., comprise a 100-in. plate mill, a regenerative-type slab-heating furnace and a sheet plant embracing six hot mills and a 72-in. jobbing mill. The plate mill, a three-high motor-driven installation, replaces a steam-driven 84-in. mill. The mill comprises a rougher and a finishing stand in tandem. The rougher, which is a two-high steam-driven 100-in. reversing stand, was retained from the old mill, while the new finishing stand represents the latest type of construction. This stand is driven by a 3,000-hp., 2,300-volt, 60-cycle, three-phase induction motor. Features of the redesigned plant are discussed. —*Iron Age*, March 13, 1924.

Present Trend of Electrical Safety in Coal Mines.—L. C. ILSLEY.—An abstract of this paper may be found in the ELECTRICAL WORLD report of the A. I. E. E. spring convention, April 19, 1924, page 768.—*Journal of A. I. E. E.*, April, 1924.

Heat Applications and Material Handling

Materials for Electric Resistances.—G. KLEIN. — Metal alloys which are suitable in every respect for electric resistances contain comparatively expensive metal components, making them available only for use on heating apparatus. A high percentage chromium-nickel-steel alloy is a good representative of this class. Research work along this line with the view in mind to devise some inexpensive alloy suitable for general resistance use has led to the discovery of a nickel-manganese-steel combination which, with certain admixtures, has remarkable properties for such use and is very low in price. Its specific resistance is 0.70 ohms per square centimeter, and its cost is one-sixth that of chromium-nickel alloy. The new alloy melts at 1,250 deg. C. and permits therefore a very high specific load without being subject to undue oxidation.—*Elektrotechnische Zeitschrift*, April 3, 1924.

Arc Welding of Copper, Brass and Bronze.—A summary of the information on this subject is given. This was compiled by the sub-committee of the American Bureau of Welding and covers electrodes, flux, welding methods, preheating speed, hammering and annealing, preparation, effects of impurities, current, porosity and uses for each metal. — *Journal of American Welding Society*, March, 1924.

Electrophysics, Electrochemistry and Batteries

Fatigue Failures of Brass Tubes.—W. E. W. MILLINGTON. and F. C. THOMPSON. — An investigation of a fatigue failure of brass tubes in a feed-water heater is described with a consideration of the nature of the "fatigue." The investigation was caused by the fact that a new heater soon after being placed in operation had five tubes fail. A study of the crystal structure of these tubes was made and the effect of various stresses on them was investigated.—*Engineering (England)*, March 14, 1924.

Recent Progress in Electroplating and Electroforming.—W. BLUM.—Developments of interest to the electroplating and electroforming industries during the post-war period are reviewed. Recent activities are considered under the following headings: (1) Research upon the principles and theories of electrodeposition; (2) research upon the deposition of specific metals; (3) reviews in literature and pedagogical activities, and (4) changes in electroplating practice.—*Paper presented before the American Electrochemical Society, Philadelphia*, April 24-26, 1924.

Telegraphy, Telephony, Radio and Signals

Underground Signaling for Mines by the Ground-Conduction Method.—J. J. JAKOSKY.—For some time the Bureau of Mines has been studying the general subject of underground communication, particularly through rock ore or coal. This has been done with the purpose of devising a communication system without wires to afford a possible means of communication in cases of mine explosions, fires or other disasters. The ground conduction or "T.P.S." method has been experimented with and signals have been transmitted obliquely through a distance of 800 ft. of rock.—*Reports of Investigations, No. 2576, of the Bureau of Mines.*

Inductive Interference in Telephone Cables.—K. DOHMEN and K. KÜPFMÜLLER.—To reduce the inductive interference between individual pairs of conductors within a telephone cable the transposition method has been introduced and popularized by American concerns. The article points out six disadvantages of this system and compares it with a principle of German origin whereby properly dimensioned small condensers are introduced into the cable, placed conveniently within the cable junction boxes. Among the main advantage claimed for this new method may be mentioned that the length of each cable piece is not limited, that no particular attention has to be paid to the sequence of wire connections, that installation is simple and faults quickly located. Curves showing the damping values of such a cable for various frequencies (3,500 to 14,000) illustrate its performance.—*Elektrotechnische Zeitschrift*, March 27, 1924.

Traction

Railways of the Japanese Empire.—S. T. DODD.—The author, who has returned from a year's study of the Japanese railway system, writes of his personal observations. After some historical notes, he describes the physical characteristics of the Imperial Japanese Railways. He cites some of the difficulties encountered in building railroads in Japan and describes the type of road bed, bridges, etc., in general use. In dealing with the rolling stock he makes some comparisons between Japanese and American practice. A most comprehensive scheme of electrification has been decided upon, with 1,500 volts direct current as a standard. This calls for a total of 336 electric locomotives in use in Japan by the year 1928.—*General Electric Review*, April, 1924.

Railway Electrification in France and Holland.—S. PARKER SMITH.—Continuing his articles on the electrification of foreign railways, the author deals with France and Holland. During the war France felt the serious effect of a coal shortage, emphasized by the fact that many valuable mines were in the enemy's hands. It was for this reason that extensive electrification of railways became a serious project, the result being the adoption of schemes to electrify an aggregate of nearly 9,000 km. of routes by 1940. The author gives a general description of the lines now electrified in France and of the systems used. At present Holland only has one electrified line, placed in operation in 1908. This is a single-phase system, of 10,000 volts and 25 cycles and is 35 km. long. This road is now operating satisfactorily although the upkeep of the early 25-cycle single-phase motors has been expensive. — *World Power (formerly Beama)*, April, 1924.

Miscellaneous

Varnishes in the Electrical Industry.—R. T. FLEMING and A. F. STEEL.—The first part of this article, published in the March issue, considers the chief characteristics of insulating varnishes, detailed uses to which they are put, the raw materials from which varnishes are made and the usual manufacturing processes. The second part continues with a description of various types of varnishes and then gives in detail some of the more common tests that are employed. — *World Power (formerly Beama)*, April, 1924.

News of the Industry

Chronicle of Important Events and General Activities, Announcements and Reports of Association Meetings, Court Decisions and Commission Rulings and News of Electrical Men

Death Removes Henry M. Byllesby

Head of Famous Utility Holding and Managing Companies Dies in Dental Office in Chicago—His Health Had Long Been Poor—Sketch of His Career

HENRY M. BYLLESBY, president of H. M. Byllesby & Company of Chicago, one of the largest holding companies in the electric light and power industry, died suddenly on Thursday, May 1, while in the office of a Chicago dentist. He was sixty-five years of age. Since the war, in which he served as a lieutenant-colonel in charge of purchases, he had suffered from angina pectoris and had been able to devote only part of his time to his organization, where his duties had to some extent been devolved upon an executive committee. He had spent the winter in California in an effort to recover. Funeral services were held in Chicago on May 3, under military auspices. The honorary pall bearers, mainly men prominent in public utility circles, included Samuel Insull, Martin Insull, John F. Gilchrist, Louis A. Ferguson, Britton I. Budd, B. E. Sunny, W. R. Abbott, Charles A. Monroe, George M. Reynolds, Henry A. Blair, Charles G. Dawes and Mayor William E. Dever.

Early Associate of Edison

Henry Marison Byllesby was born in Pittsburgh, February 16, 1859. He was educated at the Western University of Pennsylvania and Lehigh University, where he studied mechanical engineering. He left at the end of the junior year to work in a machine shop. On June 1, 1881, he joined Thomas A. Edison as draftsman on plans for the Pearl Street station in New York, the first commercial electric central station to be built in the United States. He was associated with Edison for a number of years in the construction of lighting plants in various parts of the United States, notably at Louisville and New Orleans.

In 1885 Colonel Byllesby became vice-president and general manager of the Westinghouse Electric Company, and he had a prominent part in the development of the alternating-current system of electrical transmission. He took out, in his own name or as associate inventor, approximately forty electrical patents. Later he represented the Westinghouse company in Europe, resigning in 1891 to become associated with the Thomson-Houston Electric Company interests. For a time he was stationed in St. Paul, Minn. From 1895 until 1902 he was actively engaged as an engineer and organizer of water power and public utility companies in Montana, Oregon and elsewhere, and he was responsible for the construction of several of the earlier water-power plants in the West.

On January 1, 1902, Colonel Byllesby established in Chicago the organization of H. M. Byllesby & Company. Established primarily as an engineering concern, its activities soon acquired a much broader scope, and within a few years the company became prominent in financing, designing, constructing, operating and managing electric light and power and gas companies. At present these companies, under a single management, serve 841 communities in seventeen states with 2,770,000 people.

Colonel H. M. Byllesby

Some years ago the business was divided into two departments—H. M. Byllesby & Company, with branch offices in New York, Boston and other cities, engaging in underwriting and the distribution of investment securities, while the Byllesby Engineering & Management Corporation performed specialized services for the utility properties under its administration. The Chicago organization is composed of about 450 executives and employees.

Colonel Byllesby was interested in civic affairs and was very active in preparedness efforts prior to the entering of the United States into the World War, serving as chairman of the executive committee of the Chicago Branch of the National Security League. At the outbreak of the war he volunteered for active service, entering the army November 15, 1917. He was sent overseas, received the rank of lieutenant-colonel and served as the London representative of the Purchasing Bureau of the American Expeditionary Forces, having charge of purchases in Great Britain and the Scandinavian countries. Upward of a billion dollars' worth of supplies was purchased through his office, and he made eight trips to the front. He received distinguished service medals from the United States and the British governments.

His Many Companies

Among the public utility companies with which Colonel Byllesby was connected as an officer or director were the Standard Gas & Electric Company, Northern States Power Company, Oklahoma Gas & Electric Company, San Diego Consolidated Gas & Electric Company, Western States Gas & Electric Company, Louisville Gas & Electric Company, Mountain States Power Company, Mobile Electric Company, Southern Colorado Power Company, Fort Smith Light & Traction Company and Coast Valleys Gas & Electric Company.

He was a member of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the American Society of Civil Engineers, the Western Society of Engineers and of many social clubs in Chicago, New York and other cities.

As a utility operator Colonel Byllesby's predominant traits of character have been characterized as courage, foresight, willingness to "follow through" and ability to develop and apply new methods. He was among the pioneers of customer ownership. From his utterances to his subordinates these sentences may be quoted: "Take the people into your confidence. Give them the facts. Treat them as human beings, realizing that mutual good faith and tolerance form the only basis for successful commerce between men."

Byllesby Directors Elect New Chairman and President

Directors of H. M. Byllesby & Company on Tuesday last elected Arthur S. Huey chairman of the board and John J. O'Brien president, to succeed the late Colonel H. M. Byllesby. Robert J. Graf was elected first vice-president. The same men were elected to fill these offices for the Standard Gas & Electric Company and the Northern States Power Company. All three were associated with Colonel Byllesby in the founding and upbuilding of the Byllesby organization, and with him composed

the executive committee. Henry C. Cummins and Albert S. Cummins, nephews of Colonel Byllesby, were both elected vice-presidents, the former of H. M. Byllesby & Company and the latter of the Standard Gas & Electric Company and the Northern States Power Company.

Lee De Forest Wins Radio Patent Suit

Lee De Forest of New York was declared this week by the Court of Appeals in the District of Columbia to be entitled to priority as the inventor of the audion as a means of producing sustained electrical oscillations in transmission by radio or otherwise. The opinion of the appellate court reverses the finding of the Commissioner of Patents, who had awarded priority to Edwin H. Armstrong. Claims to the invention were also made in the Patent Office and on appeal by Alexander Meissner and Irving Langmuir.

Justice Van Orsdel of the Court of Appeals said the question was one of fact merely as to whether De Forest, who admittedly first conceived the idea, had not abandoned it after reducing it to practice. The court was impressed with the testimony of Armstrong and his witnesses, who place his conception of the invention in October, 1912.

As neither Meissner nor Langmuir could go back that far, they were eliminated, in the opinion of the court, which left the question merely between De Forest and Armstrong. De Forest reduced his invention to practice in August, 1912, and the testimony failed to disclose that he abandoned it, the court found.

The decision of the New York court in a suit brought by Armstrong against the De Forest Radio Telephone & Telegraph Company, which was decided in favor of Armstrong, had no bearing, the court said, because it involved an infringement and not the question of priority.

Union Carbide Extends Muscle Shoals Bid

Gives Minimum Fifty-Year Guarantee of $120,000,000—Attack Made on Federal Power Commission—General Williams Presents Analysis of Offers

A FLAT refusal from Henry Ford to appear personally before the Senate committee dealing with Muscle Shoals on the ground that all the facts concerning his offer are before it, a criticism of the President's course by Senator Norris, an argument for the Ford bill by W. G. Waldo, secretary and consulting engineer of the Tennessee River Improvement Association, in which was included an attack on the federal water-power act as "the most misleading piece of legislation ever put over on an unsuspecting public," and an amplified proposal from the Union Carbide Company were prominent developments this week in the controversy raging at Washington, which becomes more and more political in character.

The Union Carbide Company's offer for a fifty-year lease includes a minimum guarantee of $120,000,000 to the United States government from dam No. 2 and the nitrate plants at Muscle Shoals and an agreement to manufacture a new cheap fertilizer called "urea," which, it is claimed, will make the farmers of this country largely independent of Chilean nitrates. On its face this is the most remunerative offer yet made to the government.

Mr. Waldo, who was on the stand three days and made what members of the committee evidently considered an excellent presentation of the Ford offer from the standpoint of its supporters, declared that the fifty-year limitation, prevention of excess profits, recapture of power rights, annual charges and the provision that licensees shall pay their fair share of the cost of headwater storage reservoirs are invalid under the water-power act as to licensees at private dams. He quoted court decisions in support of this statement. He asserted, however, that if the Ford offer at Muscle Shoals were put within the provisions of the act, these provisions would be operative because of the government property involved and thus would discriminate against Ford in favor of power companies building at sites not controlled by the government. The Federal Power Commission might better be abolished and the control of power-dam construction placed under the chief of army engineers, Mr. Waldo declared.

The primary hydro-electric development possible at Muscle Shoals is 241,000 hp., he asserted, and storage reservoirs in the upper Tennessee River will add only 121,000 hp. to this figure. The power necessary for the production of 40,000 tons of nitrogen per annum for fertilizer would be an average of 257,000 hp., he said.

General Williams Compares the Four Bids for Muscle Shoals

Major-General C. C. Williams, chief of the army Ordnance Department, told the committee that the necessity for preserving the nitrate plants for future war needs would pass soon owing to commercial production of nitrogen at other plants. His analysis of the various bids is printed below. He did not recommend the acceptance of any of them and expressed doubt about the whole project of fertilizer production. As shown in the table, General Williams said that under the Ford offer the government would receive a total in fifty years of $115,906,896, under the Alabama Power Company offer $134,909,320, under the Hooker plan $113,274,738, and under the Union Carbide Company plan for a fraction of the property only, as contemplated in its first offer, $36,574,200. The method of comparison set forth in the table is explained in the small-type paragraphs below:

COMPARISON OF FOUR OFFERS FOR MUSCLE SHOALS PLANTS

	Ford Offer (Interest on $34,000,000 on Dam No. 2)	Power Companies' Offer; Construction by United States	Hooker Plan	Union Carbide Company's Plan
Dam No. 2	$64,538,384	$87,600,000	$85,479,940 (Includes No. 2 steam plant)	$28,324,200
Dam No. 3	49,841,000	47,809,320	27,794,798	
No. 2 steam plant		4,500,000	(Included with Dam No. 2)	
U. S. nitrate plant No. 2	1,527,512	(Less maintenance expense		7,500,000
U. S. nitrate plant No. 1		U. S. nitrate plant No. 2		
Waco quarry		50 years, $5,000,000)		750,000
Total	$115,906,896	$134,909,320	$113,274,738	*$36,574,200

*This figure is not comparable with the totals for the Ford, power companies' or Hooker proposals, since the Union Carbide Company's offer is for only a fraction of the property. The new Carbide offer would amount to $120,000,000 for Dam No. 2 and the existing plant.

The period covered has been limited to fifty years following completion of Dam No. 2. No interest, simple or compound, on payments to the United States has been computed.

The fertilizer agreements of the various offers are not compared because there is no definite basis upon which a comparison may be made. It should be noted that in the case of the Hooker plan and in the case of the Union Carbide Company's offer, should fertilizer be made at a loss, the loss will fall upon the government and that therefore the figures shown in the attached table will be reduced by that loss if any.

In dealing with Mr. Ford's figures there is deducted from the $5,000,000 that he would pay for the nitrate plants the sum of $3,472,488, since this sum would be expended by the government in building a new steam plant on the Warrior River.

In establishing figures for Mr. Hooker's offer nothing is included for revenues on additional facilities which it is proposed should be constructed at government expense. His plan to increase the size of the No. 2 steam plant has been disregarded. This is done for the reason that no proper comparison can be made with such a considerable variation in the property as is involved in the United States expenditure of $6,000,000 to double the size of the steam plant. In the Hooker figures as tabulated the value of the power is taken from the tabulation made in the hearings of 1922 before the Senate committee on agriculture. These figures appear in the testimony of Major J. H. Burns, Ordnance Department.

ASSUMPTIONS

1. Cost of Dam No. 2 complete, $51,000,000.
2. Cost of Dam No. 3 complete, $27,331,000.
3. Dam No. 3 to be completed three years after Dam No. 2.
4. There will still be $20,000,000 to be expended on Dam No. 2 subsequent to approval of the Ford offer by Congress should the revised offer of May 31, 1922, be approved.
5. There remained $34,000,000 to be expended on Dam No. 2 on May 31, 1922, $17,000,000 having been expended prior to that date.
6. There will be no income to the United States from the manufacture of fertilizer.
7. The steam plant at United States Nitrate Plant No. 2 will be sold to the power companies for $4,500,000.
8. The power companies will expend $5,000,000 during the fifty years in maintenance of United States Nitrate Plant No. 2, this amount to be deducted from rent payments.
9. The Union Carbide Company would use power as follows: 25,000 hp. primary, 13,100 hp. on a ten months' power average, 11,900 hp. on an eight months' power average.
10. The income from sale of power under the Hooker plan will be in accord with estimates made in the Ordnance Office.

Power Bonds Not Carried

Los Angeles Apparently Fails to Cast Needed Two-thirds Majority for Issue of $21,000,000.

ELECTION returns up to Wednesday noon, May 7, indicated that the twenty-one-million-dollar bond issue for the Bureau of Power and Light of the city of Los Angeles placed before the voters of the city on Tuesday had apparently been defeated by about 6,000 votes. The count stood 84,000 for and 45,000 against, with a two-thirds majority necessary for passage. The bond issue, as explained by the Power Bureau, was for financing the cost of substations, extensions and betterments to the city's distribution system for the next three-year period. (See ELECTRICAL WORLD, May 3, page 896.)

Nebraska N. E. L. A. Meeting

Better home lighting, the future of electrical development in Nebraska and rural electrification were the chief subjects discussed at the eighteenth annual convention of the Nebraska Section, N. E. L. A., held at the Hotel Fontenelle, Omaha, on Thursday and Friday. In discussing better home lighting J. E. Davidson, vice-president of the national body, again outlined the scope of the Lighting Educational Committee for creating national interest in improved lighting in the home through school contests.

Special Law for Oswego, N.Y., May Prove Far-Reaching

Governor Smith of New York State this week signed the Augsbury bill amending the charter of the city of Oswego by authorizing that city to develop and operate power without the permission or approval of the Public Service Commission, notwithstanding the provisions of the conservation law or any other provision of any statute. The Governor has also signed an amendment to the conservation law taking out of it the provision that a municipality in order to develop and sell electrical energy in competition with an existing public utility must obtain the permission of the Public Service Commission. This latter measure, though ostensibly passed to help adjust the peculiar situation existing at Oswego, may mark a radical change in the policy of the state, since Senator Ellwood M. Rabenold, who sponsored the administration power measures, contends that it is state-wide in effect and by implication confers power upon all cities to develop or purchase power and sell it, without a certificate of convenience and necessity, both within and without their boundaries, in competition with an existing utility corporation.

The Oswego situation arose in this way: The state in constructing the Barge Canal took away a water power belonging to that city, but gave it the right to use the state property to develop electrical energy. The courts have so far sustained that right, against the exercise of which the People's Gas & Electric Company of Oswego has instituted a number of suits, one of which is now pending. The amendment to the charter of Oswego declares that the city may develop power and the conservation law amendment removes a conflicting negative provision. The People's Gas & Electric Company, the Niagara, Lockport & Ontario Power Company and the Empire State Gas and Electric Association opposed the two bills at a hearing before the Governor.

Franklin Institute Honors Coffin

Samuel Insull, in Introducing the Recipient, Pays Him High Tribute for His Foresight, Courage and Constructive Ability in the Industry

AT A MEETING of the Franklin Institute held in Philadelphia recently Charles A. Coffin, successively president and chairman of the board of the General Electric Company, until his recent resignation from the latter post, was made an honorary member. Samuel Insull of Chicago, a life member of the Franklin Institute and the donor of the Franklin medal, in introducing Mr. Coffin spoke of him as a man whose vision, courage and constructive ability signally contributed to the upbuilding of the great electrical and other industries.

After briefly tracing the life of Mr. Coffin Mr. Insull said: "The development of the electric light and power industry has been influenced to no small extent by the remarkable foresight and leadership of Mr. Coffin. Without any special scientific or technical training, but with an intuition almost uncanny, his recognition of men of great scientific attainment and of purely scientific research and the part they play in industrial development is singularly illustrated by the research laboratory at Schenectady, the establishment of which was made possible by him.

"Not alone as a manufacturer and an administrator of a great industrial organization are we indebted to him. He was among the first to recognize the desirability of bringing the use of electrical energy to every household and every workshop, and a large portion of his career has been devoted to the development and financing of electric transportation companies and local electric light and power companies and to the establishment of vast power systems conveying electrical energy from hydro-electric plants to distant points where such energy could be made subservient to the uses of mankind.

"He is a many-sided man. He has the highest possible conception of the duties of citizenship. He has the keenest appreciation of the arts of literature and of nature. . . . His charities are so catholic in character that his right hand hardly knows what his left hand does. . . . Modest beyond ordinary conception, desirous of giving credit at all times to others and claiming none whatever for himself, with a lovableness of character which endears him to his friends and having 'a vision, courage and constructive ability signally contributing to the upbuilding of the great electrical and other industries,' it affords me keenest personal pleasure to introduce the guest whom you propose to honor."

Mr. Coffin made a characteristic reply in a lighter vein and said that he knew only enough about science to love the scientist and only enough about the activities of the Franklin Institute to know that it exercises a wide and extraordinary influence.

The president of the Franklin Institute this year is W. C. L. Eglin, vice-president of the Philadelphia Electric Company.

Seated, left to right—Samuel Insull, C. A. Coffin, W. C. L. Eglin, Dr. Theodore W. Richards of Harvard University and Randall Morgan, vice-president United Gas Improvement Company. Standing, left to right—Gerard Swope and E. W. Rice, Jr., of the General Electric Company, and Dr. R B. Owens, secretary of Franklin Institute.

Combating the Drought

How the Southern California Edison Company Met a Threatened Power Shortage

THE way in which the serious situation in southern California caused by a prolonged drought, with threatened shortage of power supply, was met by the Southern California Edison Company and the great part played by interconnection in saving the situation are recounted in "Edison Facts" for April, just issued.

"The rainfall of March 23," the account says, "broke a drought in southern California which was the most serious that has been experienced for a period of forty-two years. As a result of this drought the irrigation load during the winter months of January and February created a total demand on the Southern California Edison Company's system approximately 40 per cent greater than in the same months of the previous year. Likewise, the lack of rainfall failed to add the customary generating capacity formerly derived from the stream-flow plants, with the net result that an acute situation was created, due to the excessive draft upon storage water. In fact, storage was completely depleted in some of the power companies' systems, and a similar depletion was only averted in the case of the Southern California Edison Company by the utilization of every available source of energy, to the exclusion of water from Huntington Lake.

ADVANTAGES OF INTERCONNECTION

"Interconnections with other companies made it possible to use the surplus steam capacity of such companies, and the co-operation and assistance received was of utmost value. . . . Below is given a tabulation of the several companies from which the Edison company obtained energy during the critical period:

	Kw.
San Joaquin Light & Power Corp.	20,000
Los Angeles Gas & Electric Corp.	16,000
San Diego Consolidated Gas & Electric Corp.	4,500
City of Pasadena	2,000
Pacific Gas & Electric Co.	5,000

"The energy from the San Joaquin Light & Power Corporation, being 60-cycle, is utilized by the Edison company partly in its 60-cycle system in the San Joaquin Valley, formerly called the Mount Whitney Power & Electric Company. The rest is converted to 50 cycles through a 15,000-kw. frequency changer at Vestal. The additional amount of energy from the San Joaquin company is obtained from its Kern River plant, which for the purpose is operated at 50 cycles and connected to the Edison-Kern River No. 1 lines.

"Energy from the Pacific Gas & Electric Company was made available for assistance to the Edison company by connecting a part of the San Joaquin system to the Pacific Gas & Electric Company, thus relieving the generating capacity of the San Joaquin company for use in supplying the Edison company.

"The Los Angeles Gas & Electric Company's generating system is likewise 60 cycles, and it was found possible to operate certain of its steam generating units at 50 cycles speed, connecting the same directly to the 15,000-volt system of the Pacific Electric Railway Company, which in turn is connected to and normally supplied by the Edison company. In this manner these generating units were operated in parallel with the Edison system.

"Energy from the San Diego Consolidated Gas & Electric Company is obtained through the frequency changer at Capistrano, where the systems of the two companies meet.

"The city of Pasadena operates its system at 50 cycles, and in this instance certain units were placed in operation and connected to the lines of the Edison company, which normally supplies part of its load.

"The Southern Sierras Power Company also experienced a shortage of water power due to the delayed rainfall, and through the frequency-changer installations at Colton and San Bernardino, the Edison company was able to supply this company with some energy and thus avoid serious curtailment on that system.

ISOLATED PLANTS CALLED UPON

"In addition to energy received from other operating companies numerous consumers' plants were rehabilitated, connected to the Edison system and placed in operation by the Edison organization. The intelligent appreciation by these consumers of the gravity of the situation and their readiness to come to the assistance of the Edison company with their own power plants is a fine example of the spirit of co-operation that exists in our business world today. . . .

"The rainfall of March 23 and later dates has entirely overcome the critical situation by materially reducing the load and increasing the stream-flow plant capacities, making it possible to eliminate entirely the use of storage water for a period of some weeks. This precipitation has also brought about similar results on the systems of other companies, thus creating a surplus of capacity throughout the state.

"Since April 1 the melting snows have produced the usual run-off, and the storage in Huntington Lake is now on the increase. However, the precipitation this year has been considerably less than normal, with the result that there will not be the usual amount of energy generated by the hydro-electric plants. To offset this, the company is installing one 10,000-kw. and two 5,000-kw. steam turbine generating units in the Long Beach steam plant. These will be in operation during the month of July."

Hydro-Electric Development in Western North Carolina

Sale is announced of the Canton (N. C.) Electric Company to interests associated with the Electric Bond & Share Company of New York. The purchasers are the same who last year obtained control of the North Carolina Electrical Power Company, which supplies energy to the Asheville Power & Light Company. The latter company is controlled by the Carolina Power & Light Company, and both are under the supervision of the Electric Bond & Share Company.

While the Canton company is a small one and has purchased its power from a manufacturing firm—the Champion Fiber Company, one of the customers of the North Carolina Electrical Power Company—the sale has attracted attention as possibly one step in a policy involving early development of hydro-electricity on the Big Pigeon River, where the Electric Bond & Share interests own a site for which a preliminary permit has been granted by the Federal Power Commission for the development of 45,000 hp.

Speculation on the ultimate extent of the development centers in the possibility of supplying power to industries and cities all the way from Asheville through western North Carolina. Such a system could easily be tied in with the Southern Power Company and perhaps with the Georgia Power & Light Company, thus adding greatly to the existing interconnected system of the Carolinas, Georgia, Alabama and Tennessee. It would open up possibilities of a great manufacturing development throughout the mountain section, since there are abundant natural resources in the region which need only cheap power to make them profitable.

French Electrical Association Prepares for Future

The committee of direction of the French association known as the Union des Syndicats de l'Electricité has just passed a resolution approving of the trials which are to be held next September with a view to bringing into use in France the electric vehicle running on storage batteries as developed in the United States. A plan for a general catalog to include all electric appliances manufactured or used by installations in France in either exterior or interior application was also approved. The committee on wires and cables reported specifications and prices for the supply of enameled wires and cables, and a price list for installing electrical accessories such as fuse boxes, tumbler contacts, push-buttons, etc., was indorsed. The standardization of circuit breakers and box connections was especially favored. The committee on underground cables reported experiments by the Central Electrical Laboratory and its decision to undertake further experiments along the same lines. The committee on traction and motors has worked for two years on efficiency tabulations.

The inference to be drawn from these reports and resolutions is that France is at present interested in the extension of electrical service in all of its forms and applications in view of the great supply of hydro-electric energy which will become available with the completion of the government-aided program. It will be a matter of some years before the whole project is carried out, but meantime the unification of method and standardization of accessories are going on in an effort to do away with the existing chaos.

A. E. S. Has Notable Symposiums and Round-Table Talks

Attendance records for a convention of the Electrochemical Society were broken at Philadelphia when about four hundred assembled for the forty-fifth meeting, held on April 24-26. Outstanding features of the gathering were the round-table discussions, particularly the one on refractories for electric furnaces, and two symposiums, one on electro-organic chemistry and the other on electrodeposition.

Officers for the coming year were elected as follows: President, Howard C. Parmelee, editor *Chemical and Metallurgical Engineering;* vice-presidents, F. G. Cottrell, C. F. Burgess and Carl Hering; managers, S. C. Lind, A. H. Hooker and Duncan MacRae; treasurer, F. A. Lidbury; secretary, Colin G. Fink.

New England Division of N. E. L. A. Elects Officers

The New England Geographic Division of the National Electric Light Association held its annual meeting last week in Boston and elected Fred H. Smith, vice-president Worcester (Mass.) Electric Light Company, as president; F. A. Belden, Portsmouth, N. H., as vice-president and G. M. Guilford, Boston, as treasurer. The new officers will assume their duties after the fall convention at Portsmouth, N. H.

Members of the executive committee elected were: E. M. Graham, Bangor, Me.; F. E. Webster, Portsmouth, N. H.; W. H. Richardson, Brattleboro, Vt.; L. J. Scott, Springfield, Mass.; J. E. Gray, Providence, R. I.; W. P. Schwabe, Thompsonville, Conn.; George H. Cox, Westinghouse Electric & Manufacturing Company, Boston; C. B. Burleigh, General Electric Company, Boston; F. S. Price, Pettingell-Andrews Company, Boston; A. J. Hixon, Hixon Electric Company, Boston, and S. Ferguson, Hartford, Conn., *ex officio*. Sectional chairmen appointed were: Accounting Section, I. S. Hall, Charles H. Tenney & Company, Boston; Commercial Section, J. Daniels, Edison Electric Illuminating Company of Boston; Public Relations Section, A. D. Lisle, Narragansett Electric Lighting Company, Providence; Technical Section, J. P. McKearin, United Electric Light Company, Springfield, Mass.

Canada Protests Against Lake Water Diversion

Secretary of State Hughes made public this week correspondence from the Canadian government protesting against the proposed canal from Chicago to the Gulf of Mexico and also against the diversion of water from Lake Michigan for drainage and sanitary purposes at Chicago. The letter sent by the British Ambassador on behalf of Canada says in part:

"Reports submitted to the Canadian government during recent months refer not only to the loss of levels that affect navigation, but also to the diversion of water for power purposes both in the international stretches where compensation may be determined and in the international stretches below Cornwall in the Province of Quebec. The limit of 10,000 cu.ft. of water per second, as contemplated by proposed legislation, is about 1,500 cu.ft. per second more than is being diverted at present, and the proposed legislation may mean that 10,000 cu.ft. per second is allowed for diversion and power at Lockport, while additional water power will doubtless be required for lockages."

Briefer News

St. Lawrence Valley Power Corporation Takes in Hannawa Falls Plant.—Governor Smith of New York has signed a bill permitting the Hannawa Falls Water Power Company to consolidate with the St. Lawrence Valley Power Corporation of Potsdam, N. Y.

Kansas City Company Closes Million-Dollar Street-Lighting Contract.—The Kansas City Power & Light Company has closed a contract with the municipality of Kansas City to supply electrical energy for operation of the city's pumping station which, it is estimated, will increase gross earnings about $1,000,000 a year.

Pacific Coast Branch, E. C. A.—These officers were elected for the Pacific Coast branch of the National Electrical Credit Association at its recent San Francisco meeting: President, Henry England, Oakland; first vice-president, C. W. Butterworth, Los Angeles; second vice-president, Frank Morton, San Francisco; third vice-president, H. R. Olsen, Portland, Ore.

El Paso Company Will Probably Take Over Las Cruces (N. M.) Utility.—It is said that the granting of a twenty-five-year franchise to the Las Cruces (N. M.) Light & Ice Company by the city of Las Cruces will be followed by its purchase by the El Paso Electric Railway Company, which does a light and power business in the Texas city. Las Cruces' population is 5,000.

Proposed Radio-Set Tax Eliminated.—The tax of 10 per cent on radio receiving sets, parts or accessories put into the finance bill by the finance committee of the Senate and approved by the upper house has been stricken out again as the result of vigorous protests from constituents and radio associations. The farm bloc in the Senate was solidly for repeal, saying that radio has become indispensable to farmers, who get weather, crop and market reports by its agency.

Progress of New Kentucky Systems.—The first unit of the new Pineville plant of the Kentucky Utilities Company, at Four Mile, was placed in operation on April 29, it being a 22,000-hp. unit. Work was started on June 1, 1923. A second unit is under construction. This plant will be connected with the new hydro-electric development at Dix River to serve central and eastern Kentucky, and eventually the interconnected section will reach the Louisville section. The Dix River dam is now up over 100 ft., and the plant will be completed in about a year.

Control of Laclede Gas Light Company Passes to New Hands.—The Laclede Gas Light Company, St. Louis, which owns an electrical system serving 13,000 meters, has announced that a majority of its common stock has been acquired by Charles A. Munroe, vice-president of the People's Gas Light & Coke Company, Chicago, with whom are associated the Koppers Company of Pittsburgh, the Guaranty Company of New York and T. B. Macaulay and Sir Herbert Holt of Montreal. Neither the People's Gas Light & Coke Company nor Samuel Insull, it is further stated, has any financial interest, directly or indirectly, in the Laclede Gas Light Company.

Brooklyn Edison Issues $16,000,000 New Capital Stock.—Stockholders of the Brooklyn Edison Company have been notified by President M. S. Sloan that the directors have authorized the offering of $16,000,000 additional stock at par, $100, to stockholders of record May 12. Subscriptions to the new shares will be in the ratio of four shares of the new to every eleven shares of the old in the hands of stockholders. The issue has been entirely underwritten by Dillon, Read & Company, subject to the prior rights of the stockholders. The additional stock is to reimburse the treasury for expenditures on additions and extensions of plants and facilities.

North American Company Buys Mines with Power Plant Included.—A deal was closed on April 25 whereby the coal properties of the St. Bernard Mining Company in west Kentucky, including its 6,000-kw. power plant, were sold to the North American Company, at a reported price of about $4,500,000. The surplus output of the power plant is contracted to the Kentucky Utilities Company for the next eight years. The St. Bernard mines when running with a full force use about 2,000 kw. The St. Bernard company and the West Kentucky Coal Company, the two largest mining companies in this field, are now both under the control of the North American Company.

Chicago Electric Club Plans Expansion.—The Electric Club of Chicago has adopted reorganization plans with three objectives—commercial development, an increase of membership to 1,000 and better quarters. It is the desire to set up seven commercial sections—appliance, lighting, power, wiring and construction, radio and communication, electric transportation, and public relations. Club rooms at 30 North Dearborn Street have already been selected and will afford adequate facilities. At present there are 590 members, and a drive for 410 new ones will be started

immediately. A fund of $50,000 is to be raised to carry out the program. Paul Koch is president of the club and T. C. Russell is chairman of the committee having the forward movement in hand.

City of Houston Gets Nearly $100,000 as Half of Central-Station Profits.—The Houston Lighting & Power Company has paid to the city of Houston, Tex., $95,696 as the city's half of the profits of the company over and above its authorized 8 per cent on invested capital during the year 1923. This payment was made in accord with an agreement between the electric company and Houston in effect since 1914. Capital expenditures of the electric company during the year amounted to $2,382,436, as shown by the company's report. The report also shows that the company intends to spend $5,000,000 more in Houston this year, which will include expenditure on the Deepwater steam station now under construction on the ship channel. This station is designed for an ultimate rating of 180,000 kw. and when complete will have cost $15,000,000.

Officers of Southwestern Associations.—In addition to electing J. F. Owens, vice-president of the Oklahoma Gas & Electric Company, president of the Southwestern Geographic Division of the N. E. L. A., as announced last week, the following vice-presidents were elected at the recent New Orleans convention: For Louisiana, Herbert B. Flowers, New Orleans; for Mississippi, E. E. Armstrong, Hattiesburg; for Oklahoma, Fred Insull, Tulsa; for Arkansas, C. J. Griffith, Little Rock; for Texas, Joseph H. Gill, Dallas. Besides electing G. W. Fry of Abilene, Tex., as president, the Southwestern Public Service Association named A. F. Townsend, Beaumont, Tex., as first vice-president and chairman of the Light and Power Section. S. J. Ballinger of San Antonio and E. N. Willis of Dallas were re-elected as secretaries of the Southwestern N. E. L. A. and the Public Service Association respectively.

New York Agricultural College to Forward Rural Electrification. — A meeting was held last week at the New York State College of Agriculture, Ithaca, at which this college, representatives of the State Grange, the Farm Bureau of the state, the Home Bureau and officials of electric light and power companies pledged themselves to cooperate in a permanent organization to work for the electrification of farms. Prof. H. W. Riley of the department of rural economics was authorized to appoint a permanent committee representing all of the interested groups to work for this end. Among those taking part in the meeting were Prof. P. M. Lincoln, director of the School of Electrical Engineering; S. J. Magee, president of the Empire State Gas and Electric Association; C. H. B. Chapin, secretary of that organization; Burt H. Shepard of Syracuse, chairman of its committee on rural lines, and Lucas S. Caple of the Rochester Gas & Electric Corporation.

Oil-Burning Locomotive with Electric Drive.—A new type of electrically driven locomotive using oil as fuel, the first of its kind ever manufactured in America, has been built jointly by the General Electric Company and the Ingersoll-Rand Company. This locomotive has been especially designed for switching service and may possibly be used on the Eleventh Avenue tracks in New York City, where steam engines must be abandoned in compliance with the law. The new engine weighs about 60 tons. Its power plant consists of a 300-hp. Ingersoll-Rand oil engine directly connected to a 200-kw. General Electric generator. This supplies electrical energy operating four motors, one of which is geared to each of the four axles. Sufficient fuel can be carried for forty-eight hours' continuous switching service.

Coming Meetings of Electrical and Allied Societies

[A complete directory of electrical associations is published in the first issue of each volume. See January 5 issue, page 72, for latest list.]

National Electric Light Association—Atlantic City, N. J., May 19-23. M. H. Aylesworth, 29 West 39th St., New York.

National Association of Purchasing Agents — Mechanics' Hall, Boston, May 20-23.

National Electrical Credit Association —Congress Hotel, Chicago, May 22-23. F. P. Vose, 1347 Marquette Bldg., Chicago.

American Society of Mechanical Engineers — Spring meeting, Cleveland, May 26-29. C. W. Rice, 29 West 39th St., New York.

Electric Power Club — Seaview Golf Club, Absecon, N. J., May 26-29. S. N. Clarkson, B. F. Keith Bldg., Cleveland.

Electrical Supply Jobbers' Association —Homestead Hotel, Hot Springs, Va., June 4-6. Franklin Overbagh, 411 South Clinton Street, Chicago.

Northeastern Division, A. I. E. E.—Polytechnic Institute, Worcester, Mass., June 5-6.

American Association of Engineers—San Francisco, June 11-13. C. E. Drayer, 63 East Adams St., Chicago.

Canadian Electric Association—Ottawa, Ont., June 11-13. Louis Kon, 311 Power Bldg., Montreal.

North Central Division, N. E. L. A.—Winona, Minn., June 11-13. H. E. Young, Minneapolis General Electric Company, Minneapolis.

Arkansas Utilities Association—Hotel Eastman, Hot Springs, Ark., June 12-14. R. I. Brown, Arkansas Central Power Company, Little Rock.

Associated Manufacturers of Electrical Supplies—Hotel Ambassador, Atlantic City, N. J., June 16-20. Frederic Nicholas, 30 East 42d St.

American Society of Civil Engineers—Pasadena, Cal., June 16-20.

Pacific Coast Electrical Association—Hotel Coronado, Coronado, Cal., June 17-20. S. H. Taylor, 527 Rialto Bldg., San Francisco.

Georgia Electrical Association—East Lake Country Club, Atlanta, June 18-19. W. C. Drake, 75 Marietta St., Atlanta.

Empire State Gas and Electric Association—Commercial Section, Buffalo and Niagara Falls, June 19-20. C. H. B. Chapin, Grand Central Terminal, New York.

Wyoming Utilities Association—Casper, Wyo., June 23-24. H. C. Chappell, Natrona Power Company, Casper.

American Institute of Electrical Engineers — Annual convention, Edgewater Beach (Chicago), June 23-27. F. L. Hutchinson, 33 West 39th St., New York.

American Society for Testing Materials—Chalfonte-Haddon Hall Hotel, Atlantic City, N. J., June 23-27.

Iowa Section, N. E. L. A.—Wahkonsa Hotel, Fort Dodge, June 24-26. M. G. Linn, Des Moines Electric Co., Des Moines.

Society for the Promotion of Engineering Education—University of Colorado, Boulder, Col., June 25-26. F. L. Bishop, University of Pittsburgh, Pittsburgh.

Northwest Electric Light and Power Association—Gearhart Hotel, Gearhart, Ore., June 25-27. G. H. Guefroy, Pacific Power & Light Company, Portland.

Governor of Maryland Vetoes Bill Abolishing Service Charge.—Governor Albert C. Ritchie of Maryland has vetoed a bill passed by the Legislature to abolish the service charge for gas and electric meters in that state. Defending the charge as one recognized to be proper in thirty-eight of the states, the Governor went on to say in the memorandum accompanying his veto: "The bill in question is the result of a local situation in Hagerstown, and it is not sound to prohibit the Public Service Commission from permitting a service charge because of that local situation. Nor would the bill result in the saving to the people of Hagerstown which its sponsors claim. They say that the service charges in Hagerstown amount to about $50,000 a year and that the bill would save this amount to the consumers. The fact, however, is that the amount of service charge which the Hagerstown company receives is added to the amount it receives from the flat rates it charges, and the total constitutes the company's operating revenues. If the service charge were discontinued, it would simply mean that the flat rates would have to be increased so as to yield the same amount, so that the total charge against the consumer would be the same."

Continuous Electric Lines from Boston to Detroit.—Announcement that the Adirondack Power & Light Corporation of Schenectady and the Niagara, Lockport & Ontario Power Company of Buffalo have made an agreement to construct jointly a 30-mile transmission line between Syracuse and Oneida, N. Y., has been made. This line will bridge the gap now existing between the systems of the two companies and is of peculiar interest in that when it shall be completed electric transmission lines will stretch unbrokenly from Boston to Detroit, a distance of 800 miles. Oneida is already tied in with the New England interconnected system, the Adirondack company's lines joining those of the New England Power Company at the New York-Massachusetts boundary, and the Niagara, Lockport & Ontario system is in its turn connected with the lines of the Hydro-Electric Power Commission of Ontario, which extend to Windsor, on the Detroit River, opposite the Michigan metropolis. The Adirondack company is to expend approximately $250,000 on the new line, while the Niagara, Lockport & Ontario will, in addition to building its end of the transmission system, construct a 15,000-kw. plant on the Salmon River, just below its present plant. In connection with the closing of this gap it is pointed out that if a gap of about the same length between Poughkeepsie and Peekskill, N. Y., were closed, there would also be continuous lines stretching from Detroit to New York City.

Men of the Industry

Changes in Personnel
Accomplishments, Responsibilities, Honors, Appointments and Activities of Men Engaged in all Branches of the Electrical Industry

Gano Dunn, president of the J. G. White Engineering Corporation, sailed for Europe on Saturday, May 3, aboard the White Star liner *Olympic*.

Fred C. De Weese has resigned as general superintendent of the Eastern Minnesota Power Company, with general offices at Pine City, Minn., and is now connected with the Louisville (Ky.) Gas & Electric Company in the distribution and construction department. Mr. De Weese has for two and one-half years been general superintendent for the Eastern Minnesota Power Company and prior to this connection was manager of one of the Western Utilities Company properties in South Dakota.

Charles A. Munroe, who has been identified with public utility companies in the Middle West since 1902, has been made chairman of the board of directors of the Laclede Gas Light Company, St. Louis. Mr. Munroe was formerly a vice-president of the Public Service Company of Northern Illinois and has been vice-president and a director of the Northern Indiana Gas & Electric Company and of the People's Gas Light & Coke Company as well as a director of the Middle West Utilities Company and many other utility companies. He is resigning from these organizations, both as an official and a director, in assuming control of the Laclede company.

F. H. Smith Elected President of New England Division

Fred H. Smith, who was elected president of the New England Division of the National Electric Light Association at the annual meeting in Boston, is one of the best-known central station executives in the Northeast. He entered the electrical industry in 1888 as a student in the "expert course" of the Thomson-Houston Electric Company, Lynn, Mass., and after six months was sent on the road as a trouble hunter, traveling throughout the eastern half of the country. Two and one-half years later he returned to the factory at Lynn, and upon the consolidation which formed the General Electric Company Mr. Smith was transferred to the Boston office of the company as assistant to A. R. Bush, electrical engineer for the New England district. Three years later he was appointed manager of the Manchester (N. H.) Electric Company and spent about eighteen months directing its rehabilitation. In 1896 Mr. Smith was appointed electrical engineer of the Worcester (Mass.) Electric Light Company, becoming assistant general superintendent in 1906, assistant general manager in 1911 and vice-president in 1922, which position he still holds. Mr. Smith has long been active in N. E. L. A. work. His progressive ideas, varied experience and willingness to lend a hand at all times in association work have won him the esteem of a wide circle of friends in the electrical industry, and he has been a potent factor in the excellent public relations enjoyed by the Worcester company for many years.

F. H. SMITH

H. C. Parmelee President of American Electrochemical Society

Howard C. Parmelee, for the past seven years editor of *Chemical and Metallurgical Engineering*, a McGraw-Hill publication, was elected president of the American Electrochemical Society at its recent meeting in Philadelphia. A native of Omaha, Neb., and a graduate of the University of Nebraska, he entered upon his professional career as assistant chemist with the Union Pacific Railroad Company. After serving as chief chemist at the Globe plant of the American Smelting & Refining Company, he was retained as consulting chemist to that organization from 1903 to 1905. With these years of practical experience as a background, Dr. Parmelee began his association with the technical press — an association which covers now a period of almost twenty years. From 1905 to 1907 he was editor of the *Mining Reporter*, later joining the staff of the *Western Chemist and Metallurgist*, published in Denver, Col. In 1910 he became identified with *Chemical and Metallurgical Engineering* as Western editor, and in 1917 he assumed the duties of editor, removing to New York. In addition to his connection with the American Electrochemical Society Dr. Parmelee is a member of the American Institute of Mining and Metallurgical Engineers, the American Chemical Society, the Chemists' Club and the Engineers' Club of New York.

H. C. PARMELEE

Obituary

Robert Francis Hayward, for many years prominently identified with the electrical industry in America, died early last month in London, England. A native of Harrow, England, Mr. Hayward came to America in 1894. He was connected with the old Salt Lake & Ogden Gas & Electric Light Company at Salt Lake City, the Union Light & Power Company and the Utah Light & Power Company. After spending four years with the Mexican Light & Power Company, Mexico City, he became general manager of the Western Canada Power Company, Vancouver, B. C., remaining there until 1920, when he was appointed general manager of the Chilean Electric Tramway & Light Company, Ltd., Santiago, Chile. During his career as a central-station executive Mr. Hayward was actively associated with the American Institute of Electrical Engineers.

James Berry Foote, chief engineer of the Consumers' Power Company, Jackson, Mich., died on Saturday, May 3, at his home in that city. Mr. Foote, who was born in Adrian, Mich., in 1867, had been chief engineer of the company since its organization in 1909 and chief engineer and general superintendent of some of its predecessors since 1887. A pioneer in the development of hydroelectric power and transmission at high voltage, he designed and constructed the entire transmission system of the Consumers' Power Company. Although Mr. Foote's name had always been identified with transmission construction and design, his activities had not been confined to this phase of electrical engineering, for he had met with signal success in electric railway design and construction. In addition to his connection with the Consumers' Power Company of Michigan he was a director of the Commonwealth Power, Railway & Light Company and of the Michigan Light Company. In recognition of his important contributions to electrical development the honorary degree of master of engineering was conferred upon him in 1918 by the University of Michigan. A detailed appreciation of Mr. Foote appeared in the April 28, 1923, issue of the ELECTRICAL WORLD.

Recent Court Decisions

Question of Constitutionality of State Act Must Be Taken to State Courts First.—In Colorado Power Company vs. Halderman the United States District Court of Colorado held that the Colorado public utilities act being susceptible of a construction rendering it constitutional as respects the requirement of due process of law, since it provides independent judicial review of the commission's orders, the question of the unconstitutionality of the act on that ground cannot be raised in the federal court by a utility company complaining of an order of the commission as to its rates until the utility has raised the question in the state court, or unless decisions of the highest state court have construed the act as to the extent of judicial review afforded thereby. (295 Fed. 178.)*

Protection from Confiscation.—That the state has no power to compel a public utility to serve without reasonable compensation was emphasized by the Supreme Court of Illinois in Edwardsville vs. Illinois Bell Telephone Company. The decision said: "The power of the Legislature over rates to be charged is not absolute, but is limited. It is the power to regulate and not to confiscate. It is a legislative power to fix rates, but it is a judicial question whether the rates fixed are such as to deprive the public utility affected of its property without due process of law. The owners of property invested in public utility corporations are entitled to the equal protection of the law which is guaranteed to all, and they are deprived of it and of their property if the rates fixed by law are so low as to prevent the companies from earning any compensation for the use of the property after keeping it in repair and paying the expenses of operation." (142 N. E. 197.)

Part of Interstate Gas Supply May Be Diverted to New Consumers.—The West Virginia Supreme Court of Appeals has affirmed an order of the Public Service Commission of West Virginia requiring the United Fuel Gas Company to furnish service to the residents of a new territory through which the company's mains run. The court held that, although the gas would be supplied from the interstate pipe line, the order was not void merely because it required the company to furnish a small portion of its interstate supply to new consumers since this did not constitute an unlawful interference with the interstate commerce of the company. Referring to the contention of the company that the governing decision was that of the Supreme Court of the United States holding a West Virginia statute unconstitutional because it gave an unlawful preference to consumers of gas in the state over consumers in other states, the court said: "If the company's contention were sound, then it could not be compelled to furnish gas to a single new customer in West Virginia, even where it is operating under a municipal franchise, because this might require it to divert a small portion of its gas in its mains which would otherwise go to a consumer in another state. We do not think the Supreme Court of the United States in its opinion in the case cited meant to go that far." (121 S. E. 281.)

Finding for Radio Corporation Stands.—The United States Supreme Court has noted its refusal to review a suit filed against the Radio Corporation of America and the De Forest Telephone & Telegraph Company by Alfred Emerson and others in which the question was raised whether the American Telephone & Telegraph Company, owner of the De Forest patents, could authorize by contract the Radio Corporation to sue for infringement of patents relating to radio. The District Court decided in favor of the Radio Corporation, and this finding stands.

Knowledge of Dangerous Wires Is Not Contributory Negligence as Matter of Law.—On a rehearing of Saylor vs. Enterprise Electric Company (ELECTRICAL WORLD, March 22, page 598), the Supreme Court of Oregon reiterated that mere knowledge on the part of one attempting to disengage a hay derrick from electric wires that these wires carried a dangerous voltage does not constitute contributory negligence as a matter of law and that therefore that issue was rightly left for the determination of the jury. Such negligence becomes a question of law only where the testimony is so plain that no reasonable man could doubt that the negligence existed. (233 Pac. 725.)

Interstate Character of Shipment of Gas Held to End at State Line.—In affirming decrees of the Pennsylvania Public Service Commission relative to the People's Natural Gas Company, which sued the commission to have them annulled, the Supreme Court of Pennsylvania said, among other findings, that "where natural gas is bought in an adjoining state by a Pennsylvania company for delivery at the state line, the quantity to be there ascertained by meter measurement, the interstate character of the shipment ended at such line, and it did not continue while the gas was being taken by the company in its pipes through the state for sale in installations at various points therein." (123 At. 799.)

Findings of Lower Court Sustained Against Law's Presumption that Commission Order Is Valid.—Sustaining the lower court in State ex rel. Hopkins vs. Southwestern Bell Telephone Company, where the rates of the Public Utilities Commission were overruled, the Supreme Court of Kansas said: "On an appeal from a judgment enjoining the Public Utilities Commission from establishing a rate for the public utility, the Supreme Court will not reverse the judgment of the trial court based on findings of fact and conclusions of law made by a referee appointed by that court to make such findings of fact and conclusions of law, where the conclusions of law are correctly applied to the findings of fact, and where there is evidence to establish clearly the findings of fact made by the referee, notwithstanding the presumption of law in favor of the validity of the order of the Public Utilities Commission." (223 Pac. 771.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

Deposits from Customers Must Be Uniform.—The North Dakota Board of Railroad Commissioners has forbidden the Hughes Electric Company to demand a double deposit from a consumer thought to be untrustworthy. "A public utility company," the commission says, "cannot refuse to serve a consumer merely because his credit is poor in the community; neither can a public utility arbitrarily demand a greater deposit from one consumer than it does from another for a like service. If this practice were permitted, a utility could sit in judgment and require a five-dollar deposit of one consumer, a ten-dollar deposit of another and a twenty-five-dollar deposit of another. This would result in a discrimination. We do not presume to substitute our judgment for that of the management, but we do hold that if a utility, in the exercise of its business judgment, determines that the meter deposit of $5 is insufficient protection, and it is desired to require a larger deposit, such deposit rule must be filed with the Board of Railroad Commissioners and a showing made establishing that such higher rate is justified."

Apportionment of Investment Among Classes of Service.—In an investigation of the electric rates of the city of Elkhorn the Wisconsin Railroad Commission apportioned the investment in lands and buildings attributable to the municipal electric plant among four different classes of service—lighting, power, street lighting and farm lighting—upon the basis of their respective demands. The investment in poles and fixtures in the utility's distribution system was apportioned to the different classes of service on a contact basis. Wire, with exception of street-lighting circuits, which were charged directly, was apportioned on a demand basis. Transformers were apportioned on the relative dem of the different classes of service. Meters were charged directly to the class of service by which they are used. The apportionment of the plant equipment was made upon the basis of the results determined from the apportionment of the distribution system. General equipment was allocated to the different classes of service on the same basis as that used for plant equipment. Materials and supplies were handled in the same manner.

Business Conditions

A Survey of Important Developments in the Electrical Market Including Data on Production, the Sales Outlook, Credits, Exports, the Metals and Other Conditions Affecting Cost, Supply and Demand

ELECTRICAL manufacturers report a good business compared with sales totals at this time last year. The aggregate billings may be less, but it must be remembered that there was an avalanche of buying last spring with all the reactions of a boom. The record figures of 1923, therefore, will permit a considerable drop in present sales without business this year falling below normal. The steady healthy buying of this season continues to roll up very satisfactory totals.

The feeling is undoubtedly spreading among electrical men that they are in a very fortunate position. General business has been slowing down, and this tendency will probably continue, but the electrical business is good, for the basic, financial and economic conditions of the country are sound and stable, although political disturbances in Washington still breed uncertainty and hesitation. The industrial market for electrical products is off, but building continues on a basis better than normal, central-station buying has great volume and the popular market is most promising.

In New England conditions are still spotty with central-station buying of heavy apparatus the strong note. The volume of business in the New York district is fair, but the market is conservative and tending to further slow up. The Southeast reports active building and an improvement in the sale of retail lines. Jobbers are buying from hand to mouth in the Middle West, although in satisfactory volume to meet demands. Business on the Pacific Coast is good in spite of a discouraging general outlook.

Material-Handling Equipment Orders Reflect Good Conditions

THE manufacturer of material-handling equipment, whose product goes into practically every industry, has an unusual opportunity to be informed on general business. A representative of the ELECTRICAL WORLD, therefore, this week interviewed Charles Piez, president of the Link Belt Company, with plants in Chicago, Philadelphia, Indianapolis and on the Pacific Coast and offices in the principal industrial centers. Mr. Piez summarized the status of the company's business as follows:

"Our plants as a whole are running at 85 per cent of their normal weekly forty-eight-hour capacity. The Philadelphia plant did not show up so well in January, February and March, but there was a large increase in orders and production in April, and we look for a continued upward trend in the Eastern territory. For the Middle Western plants business has been brisk, and the same applies in increasing measure to the West Coast plant and office.

"Assurance of legislation still further restricting immigration makes material-handling by machinery necessarily a growing business. Foundries and the coal mines, in particular, are now buying in increasingly large volume. Such hesitation as exists on the part of buyers is due, so that buyers themselves state, to the disturbance of the forthcoming election and the Washington political situation. Financial and business conditions of the country generally, however, are sound and stable."

Price Cutting Prominent in Tape Market

ALTHOUGH a fair volume of business is reported by leading tape producers, considerable complaint is heard about price cutting by makers of what might be called sub-standard grades. In some cases a spread of 5 cents or 6 cents, per pound has been noted between quotations of different manufacturers, but there is some evidence that at last purchasers are beginning to appreciate the primary value of quality and the secondary importance of price in this class of material. Here and there customers who have purchased tape at cut prices are returning to their former producers on account of the low grade of material obtained, and a prominent manufacturer stated last week that conditions are admittedly better in this respect than a year ago. Much criticism is constantly being heard of the policies of so-called "fly-by-night" producers who buy up remnants and odds and ends of sheeting, fabricate them into tape of dubious quality and sell this at particularly low prices. Well-informed observers point out that this practice marks a sort of cyclic condition in the tape industry which will give way to a better understanding of "quality" goods before many years.

Orders and output are exceptionally satisfactory, considering general business conditions. One large house is receiving a practically normal flow of orders and is working close to its full production rating. Another house is selling perhaps 15 per cent less tape in dollars equivalent than a year ago, although its quarterly business ended March 31, last, exceeded that of a year ago by about 200 per cent. This house is running its tape department day and night, but is not taking in the maximum quota of new business, finding this period running true to form and not expecting much increase before August 1. Some gratifying sales have been made of late to English buyers, but sales to Australia are reported dull owing to tariff prohibitions, and the movement of tape into Canada is only fair for the same reason. Raw material is plentiful, and in tape circles it is said that 98 per cent of sales are now of black tape, the rest being of white and gray. The demands of the building industry are not as active as last year.

Wider Interest in Electric Trucks —Demand Increasing

THERE is to-day a wider and greater interest evidenced in the electric truck which is substantiated by the reports of various manufacturers. The consensus of facts show that the demand is probably somewhat greater than it has been in the past, although the total production of electric trucks during the past year has not been so much greater than previous years as to warrant unbounded enthusiasm regarding the future. However, most manufacturers are reporting quite an increase in present inquiries, which is attributed largely to aggressive sales policies and to the wider acceptance of the electric truck by business men generally. The central stations have in no small measure contributed to this increased interest in the electric vehicle. Without a doubt the electric truck schools attended by representatives of the various utility companies have given a distinct impulse to the situation.

Deliveries of standard equipment can be made in from thirty to sixty days. Where off-standard equipment is desired deliveries may be somewhat delayed. One of the limiting factors of deliveries is equipment entering into electric truck manufacture, as motors. Last price revisions made by manufacturers were downward, and while no price revisions are now contemplated, the tendency is to furnish additional equipment without increase in price, although there has been some increase in the cost of raw materials.

Manufacturers believe that there will be a steady increase in the demand for electric trucks if all the interests involved, including those which make motors and charging equipment as well as those interested in the sale and generation of energy, keep steadily at their campaigns of education and aggressive selling. It is further believed that intelligent application of electric trucks is essential to continued increase in demand, with transportation engineering an indispensable asset with every sale. One of the greatest needs of the industry to-day is felt to be the more general employment of a high type of engineering salesman.

Low Armored-Cable Prices Foster Unscrupulous Practices

ARMORED cable is reported as being in good demand by manufacturers and jobbers. Deliveries are also in good shape and so are stocks. But from all sides the complaint is heard that with the present highly competitive condition and correspondingly low prices the business is on a most unprofitable basis. Representative men in the industry can see no change in this situation for some time to come. When manufactures realize that cable must be sold at a price not only sufficient to pay current expenses but also to pay interest on their investment, then perhaps cut-throat competition will be discontinued and the industry will be on a more stabilized basis.

This condition has caused unscrupulous concerns to resort to questionable practices, and in more than one instance reputable wire companies have been

requested to furnish wire below code standard but have felt compelled to decline orders under such conditions. To make wire of code standard it is necessary to allow for a variance in wire sizes from code minimum to twenty-thousandths above, as the wire manufacturer cannot work to closer limits. This uses more rubber and is slightly more costly than if it were possible to keep the size absolutely uniform. Some armored-cable companies, however, knowing these facts, have approached concerns manufacturing wire and asked them to work within a five-thousandths leeway, which in effect is a request to furnish wire below code standard.

At present the underwriters allow a minimum inside diameter of armor which is thirty-thousandths below the minimum code wire diameter so that once a cable is made up it is always possible to disguise under compression wire that originally was below code standard.

Copper Exhibits Strength in Downward Metal Market

THE non-ferrous metal market is still exhibiting a downward trend with the exception of copper. Lead and zinc have been particularly weak, probably due to the decline in the London market. It is believed that liquidation of the speculative lots of the metals abroad has almost run its course. Distress selling of these lots has undoubtedly disturbed the market during the last few weeks.

A fair volume of copper was sold during the week at from 13¼ cents to 13⅜ cents, with some sales as high as 13½ cents. Requests for quick delivery of the metal indicate that stocks in the hands of consumers are low. Competition for business is still keen, with some producers willing to sell at 13¼ cents but most are asking 13⅜ cents.

NEW YORK METAL MARKET PRICES

	April 30, 1924 Cents per Pound	May 7, 1924 Cents per Pound
Copper, electrolytic	13.30	13¼–13⅜
Lead, Am. S. & R. price	8.0	7.50
Antimony	9¼	8¼
Nickel, ingot	27	27
Zinc, spot	6½	6.10
Tin, straits	47⅛	47
Aluminum, 98 to 99 per cent	28	28–29

Heavy Apparatus in Active Demand in New England

THE demand upon electrical manufacturers for turbo-generators, waterwheel units and large transformers constitutes an underlying market condition in New England favorable to the longer outlook for business, as within a few months the installation of such apparatus will inevitably be followed by the sale of a correspondingly increased quantity of smaller equipment and supplies. Central-station expansion continues toward levels of development little short of amazing in view of the spotty conditions found in other industries. Applications for service are piling up so fast in some companies that it is difficult to overtake them.

Wiring material and pole-line supplies are moving well, and the outlook is good for purchases during the summer by contractors, although high labor costs have delayed the signing of some building agreements, notably one for a large hotel at Boston. Retail sales are uneven in the electrical trade, the lighter appliances moving fairly well except in industrially depressed sections. Electric motors are selling at about 75 per cent of the dollar volume of a year ago, and prices are weak. Conduit boxes and attachment plugs are weak on factory quotations. Deliveries are in excellent condition.

Business Slows Down in New York District—Fair Volume

BUSINESS in the New York district has shown a distinct slowing up in all lines. The conservativeness of buyers is becoming more marked and there seems to be a general attitude of watchful waiting. The greatest activity is noticed in utility construction material. The demand for industrial equipment is light, with the possible exception of fractional-horsepower motors, and stocks are ample to meet reasonably fair demands.

Building construction lines are moving fairly well, but have also shown a slight decrease. Because of the continued open weather, these lines enjoyed a good demand distributed throughout the winter, so that naturally the usual spring increase has not materialized. Fans for ventilating and heating purposes have been having good sales and jobbers are as a rule well prepared to meet the coming fan season. Probably the brightest spot in the jobbing industry is the sale of incandescent lamps, the business in which has been gradually increasing. Although present conditions show a gradual falling off of business, the general feeling is that there will be a reasonably good market throughout the year. Radio business, which started to slow up a short time ago, is now showing a considerable falling off. The vacuum-tube shortage accordingly has been relieved, owing to the lessening of the demand. Dealers are very much pleased with the knowledge that the proposed radio tax has failed to pass Congress.

Retail Lines Showing Improvement in Southeast District

WHILE business in electrical retail lines showed some improvement last week in the Southeast, there are no high lights to be recorded regarding electrical business generally. All jobbers report an excellent business in supply lines, and this should continue now that spring construction is being started. Building permits in Atlanta for the month of April were in excess of $1,500,000.

The usual seasonal activity of flatirons has been stimulated by sales campaigns, and a brisk demand for this specialty is reported, with sufficient stocks the rule. Electric ranges have been moving satisfactorily, and on May 1 several large central stations in the Southeast began sales campaigns that should considerably boost the volume of business in this line for the next thirty to sixty days. Vacuum cleaners continue to grow in popularity, and manufacturers' representatives report very good sales. This is due not only to sales work in the large centers but to the opening up of new territories. One manufacturer, having an outlet in a large department store, recently put on a sale of rebuilt vacuum cleaners and reported excellent results.

Middle West Trade Holds Up Well, Although Cautious

CENTRAL-STATION purchases for the Middle West continue active despite indicated depression in some lines of industry. Most of this ordering is mainly for standard equipment necessary for extension of lines and substation construction. Substantial orders were placed this week for distribution transformers and bare copper cable. Most commodities are holding up well, although the spirit of caution is still prevalent with regard to the placing of large orders.

Building activity continues and the demand for building material is quite active. Though the jobber and dealer are virtually buying on a hand-to-mouth basis, the volume of business transacted is quite satisfying. There is an aversion toward stocking up with more merchandise than is sufficient to satisfy demands for present consumption—a condition that is also found in other industries. Industrial heating sales have been good, particularly in hotel and restaurant equipment. A substantial volume of business was obtained this week from the sale of kitchen units. Extensive campaigns for better lighting are still being conducted and are very successful. Radio sales are about the same this week, although intensified advertising, together with aggressive sales effort, has improved last week's average.

Good Business on Pacific Coast Marred by Outlook

PRESENT business conditions on the Pacific Coast resemble a stream which has been temporarily dried up at the source but whose water is still flowing past a given point in large volume. Real-estate conditions and tighter credits are expected to curtail new building construction, especially in southern California. Decreased railroad freight receipts caused by cattle-epidemic embargoes have delayed certain new railroad business. These causes have directly influenced electrical conditions, and the prevailing caution has been reflected in a disproportionate increase of the number of small orders.

Motor prices have dropped about 5 per cent, stocks are ample and sales are in good volume. Lamp business is running close to last year's through increased industrial buying, but individual dealers report lower sales because of the sunny winter. The demand for fuses of the non-renewable type has increased about 30 per cent, while the demand for renewable fuses has remained reasonably steady. Tape is selling about 10 per cent better than last year, but the offering of inferior products has tended to weaken sales. Heating appliances are moving very slowly, but sales campaigns to be put on early in June are expected to enliven the line.

Activities of the Trade

Devoted to News of the
Manufacturer, Jobber, Agent, Contractor and Dealer, Including Important Orders and Contracts for Apparatus and Equipment

Anaconda Copper Reports Record Volume of Business

The Anaconda Copper Mining Company in its report for the year ended December 31, 1923, shows a net income of $8,767,814, after interest, taxes, depreciation and other charges have been deducted. This compares with $3,530,877 for the preceding year. The company failed to earn the $9,000,000 disbursed in dividends during the year by a margin of $232,186.

John D. Ryan, chairman of the board, in the report says that continued over-production broke the price of copper in 1923 from a high of over 17 cents in March to a low of 12.188 cents in October. Output was increased throughout the year, starting at 200,000,000 lb. a month in the early part and ending with 240,000,000 lb. a month. World production of copper he places at 2,700,000,000 lb. and consumption at 2,600,000,000 lb., both records for any peace year. Domestic apparent consumption was 1,376,000,000 lb., compared with 1,104,000,000 lb. in 1922, an increase of approximately 25 per cent.

In 1923 Anaconda's volume of business was largest in its history, but the low price of copper prevailing during latter half of the year made it impossible to realize earnings commensurate with the business done. The year 1923 was one of marked expansion. The balance sheet discloses that the company was in a strong financial position at the end of the year. Current assets were reported at $102,544,725, against current liabilities of $19,864,011, leaving a net working capital of $82,680,714.

Allis-Chalmers Reports Earnings for March Quarter

The Allis-Chalmers Manufacturing Company for the quarter ended March 31, 1924, reports a net profit of $831,180, after provision for federal taxes. This compares with $468,690 for the corresponding quarter in 1923. Unfilled orders on hand on March 31, 1924, amounted to $10,876,155, as compared with $12,000,132 on December 31, 1923.

Steel Companies on Pacific Coast Expected to Consolidate

The Pacific Coast Steel Company, San Francisco, manufacturer of steel poles and transmission towers, will before long, it is rumored, consolidate with the Pacific Sheet Steel Corporation, San Francisco, and the Metal & Thermit Corporation of New Jersey to form the nucleus of a great steel industry in the West.

The Pacific Sheet Steel Corporation, recently organized, a subsidiary of the Metal & Thermit Corporation, began operation of its new rolling mill April 14, converting the Metal & Thermit Corporation's residue of tin scrap into black-galvanized and blue-annealed open-hearth steel sheets. It represents an estimated investment of $1,500,000 and employs two hundred skilled workmen. The reducing operations of the Metal & Thermit Corporation's plant are handled by the Pacific Coast Steel Company.

Kuhlman Electric Company Opens New York Office

The Kuhlman Electric Company, Bay City, Mich., manufacturer of transformers, has opened a sales office at 300 Madison Avenue, New York, in charge of D. F. Potter, Jr. Mr. Potter, who is a graduate electrical engineer, has been sales engineer for the Kuhlman Electric Company in Buffalo for the past year. Prior to that he was connected with the Robertson-Cataract Electric Company of Buffalo as sales manager.

New Boston Engineering Firm

Barzillai Allen Rich, William Walter Bigelow and Charles Edwards Tirrell have formed a partnership under the name of Rich, Bigelow & Tirrell, with offices at 333 Washington Street, Boston, for the practice of civil, mechanical and power development engineering, continuing the business formerly conducted by Stone, Bigelow & Tirrell at Boston.

General Electric Erecting New Buildings at Pittsfield

To provide for the economical handling and manufacture of large transformers, the General Electric Company is erecting two new buildings at its Pittsfield plant. This increase in manufacturing facilities follows the rapidly growing tendency toward power transmission at voltages of 220,000, involving a great increase in the size of transformers for the efficient transmission of large amounts of power.

The larger of the two buildings will be erected immediately east of the high-voltage laboratory. The structure will be of brick and steel construction, 400 ft. long and 86 ft. wide, equipped with 100-ton cranes having a lift of 43 ft. The building will contain a pit 17 ft. deep for a large vacuum treating tank.

The plan of manufacture is to assemble, treat, test and ship the large units all in one building. The assembly operation will start at one end of the building and follow a continuous process in one direction, the finished transformers to be shipped on the railroad tracks at the other end of the building. Plans call for completion of the building, ready for occupancy, by November 1, 1924. The second smaller building, to be used for the manufacture of concrete core reactors, is expected to be ready for occupancy by August 1, 1924.

The Cole Metal Products Company, Inc., 330 East Twenty-third Street, New York, manufacturer of metal boxes, etc., has had plans prepared and is erecting a new plant, 100 ft. x 200 ft., on property recently acquired on Harris Avenue, Long Island City.

The Eagle Electric Porcelain Company, Chadwick Street, Trenton, N. J., has completed plans for the erection of a one-story addition, estimated to cost $10,000.

The Westinghouse Electric & Manufacturing Company and the **Westinghouse Lamp Company** have recently moved to new offices in the Chamber of Commerce Building, Pittsburgh, owing to increased demands of business in the Pittsburgh territory having necessitated greater facilities and personnel than the former offices in the Union Bank Building would accommodate. J. McA. Duncan is in charge of the office.

The General Electric Company has completed plans for the erection of a five-story factory branch and distributing warehouse at Third and Antoinette Streets, Detroit, and plans to begin work at an early date. It will be 75 ft. x 200 ft., estimated to cost $300,000, with equipment.

The Garfield Manufacturing Company, Garfield, N. J., manufacturer of heat-resisting insulation, announces that it is constructing a new two-story brick building and is making additions to existing buildings which will add a total of 10,000 sq.ft. to its present plant in order to take care of the demand for its products.

The American Lava Corporation, Chattanooga, Tenn., has put on the market a complete line of lighting fixtures and glassware under the trade name of "Alco." The line, illustrated in the catalog and shown in the actual colors, is always carried in stock and all orders received are shipped on the same day. It is intended that the dealer shall purchase and display samples only, merchandising from them and mailing his orders as he receives them, relying upon speed of delivery for reception of the articles in time for installation.

The Westinghouse Electric & Manufacturing Company has received an order from the Utica Gas & Electric Company for two 17,500-kva. turbo-generator units and switching equipment amounting to more than $500,000.

The Otis Elevator Company, Yonkers, N. Y., has preliminary plans under advisement for the erection of an addition to its local plant on Atherton Street to cost in excess of $125,000. It is expected to take bids late in the summer.

The Blaw-Knox Company, Pittsburgh, announces the appointment of Irving A. Pfeil of the Chicago office as manager of the Detroit branch, succeeding Herbert J. Desson, who died recently. Mr. Pfeil graduated in civil engineering at Ohio Northern University and has been with the company since 1919.

New Trade Literature

INSULATING FABRICS AND PAPERS.—A booklet, known as folder 4,532-A, has been issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., covering the "Westinghouse" fabrics and papers for insulating purposes.

ELECTRICAL TESTING IN INDUSTRY.—This is the title of a new well printed and illustrated publication of 95 pages issued by the Weston Electrical Instrument Company and designed to help industrial plant engineers in their work. Although not intended as a textbook, its twenty-two chapters and tabular appendix contain many suggestions that have proved of value in conducting electrical tests over a long series of years. The company emphasizes the fact that its interest extends further than the sale of electrical instruments and that it stands ready to answer any letters on problems not solved in the book itself.

MERCURY-VAPOR PROCESS. — The General Electric Company, Schenectady, N. Y., has issued bulletin Y-1910, entitled "The Emmet Mercury Vapor Process," which describes the vaporization of mercury for driving turbines. It contains illustrations of equipment for this purpose as installed in the Dutch Point station of the Hartford Electric Light Company, Hartford, Conn.

LAMP MAINTENANCE EQUIPMENT.—Catalog B-22 issued by the Thompson Electric Company, 226 St. Clair Avenue, N. E., Cleveland, covers the "Thompson" safety disconnecting hanger.

ELECTRIC CONTROLLING APPARATUS.—The Allen-Bradley Company, Milwaukee, is distributing bulletins Nos. 600, 720 and 740, covering its alternating-current resistance starters, type J-1552 "Across-the-Line" starting switch, and type J-3052 automatic resistance starter, respectively.

METAL-COATING PROCESS. — "Metal Layer Schoop Process" is the title of a bulletin issued by the Metals Coating Company of America, 495 North Third Street, Philadelphia, which describes and illustrates the method of coating iron and steel with lead by the Schoop process of metal spraying.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An agency is desired in Shanghai, China (No. 10,015), for small electric lighting plants and for a small ice-making plant.

An agency is desired in the Far East (No. 10,038) for electrical supplies and specialties.

Purchase is desired in Queenstown, Ireland (No. 10,033), for radio apparatus and parts.

An agency is desired in Port Elizabeth, South Africa (No. 10,036), for radio apparatus and parts.

Purchase is desired in Darien, Manchuria (No. 10,032), for ozonizers.

An agency is desired in Montevideo, Uruguay (No. 10,022), for 5,000 kilos of oil for electric transformers.

EQUIPMENT FOR POWER STATION AT CONCEPCION DEL URUGAY, ARGENTINA.—Tenders will be received by the Department of Sanitary Works, Argentina, until May 26 (extended date) for equipment for electric power plant at Concepcion del Uruguay.

MACHINERY AND EQUIPMENT FOR ELECTRIC POWER STATION AND PUMPING STATIONS AT PERGAMINO, ARGENTINA.—Tenders will be received by the Department of Sanitary Works of the Nation, Argentina, until May 28 for machinery and equipment for an electric power station and pumping stations in the town of Pergamino, for the Obras Sanitaries de la Nacion, Argentina.

TELEPHONE EQUIPMENT, ETC., FOR CHILEAN STATE RAILWAYS.—Tenders will be received by the Chilean State Railways, signaling department, until May 26 for telephone equipment, etc., as follows: (B) Table and wall telephones, switchboards, fuses, etc.; (C) copper and galvanized-iron wire and cables; (D) galvanized-iron anchors for posts, stays, insulator pins, etc.; (E) cast-iron covers for cable boxes, padlocks, galvanized-iron piping, lead tubes, etc.; (F) dry cells and material pertaining thereto; (I) insulators, bell-shaped.

INCANDESCENT ELECTRIC LAMPS, ETC., LEAGUE OF NATIONS, GENEVA.—Tenders will be received by the League of Nations until May 31 for a supply of incandescent electric lamps, etc. Particulars may be obtained from office No. 1, Secretariat of the League of Nations, Quai du Mont Blanc, Geneva.

New Incorporations

THE WOOD COUNTY ELECTRIC LIGHT & POWER COMPANY, Wisconsin Rapids, Wis., has been incorporated by W. E. Seward, Ripon, and C. B. Miller and Franklin Miller, Wisconsin Rapids. The company proposes to erect a transmission line from Wisconsin Rapids to Vesper to supply electricity to towns along the proposed line. W. E. Seward is president.

THE HINTON ELECTRIC TRANSMISSION COMPANY, Columbia, Mo., has been incorporated by W. A. Bright, W. J. Carter and others.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

LOWELL, MASS.—Initial plans for the installation of a new lighting system for the city similar to that on First Street Boulevard are under consideration by the Board of Public Service. It is proposed to install new lamps on Bridge, Church, Andover, Fletcher, Pawtucket, Upper Merrimack, Gorham and Central Streets.

QUINCY, MASS.—The Edison Electric Illuminating Company has applied for a franchise to install an underground conduit system in Adams and Hancock Streets.

DANBURY, CONN.—The G. McLachlan Hat Manufacturing Company will soon take bids for the construction of a power house at its lcoal factory, to cost about $55,000. Fletcher-Thompson, Inc., 542 Fairfield Avenue, Bridgeport, is engineer.

Middle Atlantic States

EAST WORCESTER, N. Y.—Joint petition has been made by the Great Bear Light & Power Company, East Worcester, and the Fulton County Gas & Electric Company, Gloversville, for permission to transfer the property of the Great Bear company to the Fulton County company, which has extended its transmission lines to towns adjoining those served by the Great Bear Company.

INDUSTRY, N. Y. — Bids will be received by Mrs. Warham Whitney, president of board of managers, State Agricultural and Industrial School, until May 14 for construction, sanitary and electrical work in connection with rebuilding hospital at the above institution. Sullivan W. Jones is state architect.

KINGS PARK, N. Y.—Bids will be received by the State Hospital Commission, Capitol, Albany, until May 21, for installing a fire-alarm system, etc., at the Kings Park State Hospital. For details see Searchlight Section.

LONG ISLAND CITY, N. Y.—The Astoria Silk Corporation, 723 Steinway Avenue, has engaged Ophus & Hill, 112 West Forty-second Street, New York, N. Y., engineers, to prepare plans for an addition to its power house to cost about $200,000, with equipment.

MOUNT MORRIS, N. Y. — The Mount Morris Illuminating Company is planning to complete the installation of the new lamps in Main, Chapel and Erie Streets.

TROY, N. Y.—The Troy Coke & Iron Company, recently formed by officials of the Burden Iron Company, with local plant, plans for the construction of a power house at its proposed steel mills, estimated to cost $1,500,000. It is expected to begin work in June.

DOVER, N. J.—The New Jersey Power & Light Corporation has secured permission to issue bonds for $325,000 and stock for $79,000, a portion of the proceeds to be used for extensions in transmission system.

JERSEY CITY, N. J. — The Hudson Boulevard Commission has contracted with the Public Service Electric Company for lighting the boulevard for a period of five years, at $75 per lamp per year.

DURANT CITY, PA. — W. A. James, Kane, Pa., and associates plan to construct a power house at their proposed local glass manufacturing plant to cost about $1,500,000. A company is being organized to construct and operate the works.

PHILADELPHIA, PA. — The Philadelphia Electric Company has filed plans for the construction of a substation at Wister and Olney Streets, to cost about $70,000.

SAYRE, PA.—Bids will be received by the Sayre Water Company until May 15, for improvements to water plant, including extension to pumping station, electrically driven centrifugal pumping units, steam-engine-driven centrifugal pumping unit, etc. Charles C. West is manager.

WILMINGTON, DEL.—The Wilmington & Philadelphia Traction Company has filed plans for extensions and improvements in its substation at 211 West Fifth Street.

ANNAPOLIS, MD.—The navy purchasing officer, navy yard, has been authorized to purchase six direct-current motors, as specified in Naval Requisition 459.

HOPEMONT, W. VA.—The State Board of Control, Charleston has authorized the construction of an electric power plant at the local state tuberculosis sanitarium, to cost about $50,000.

COVINGTON, VA. — Plans are under consideration to build a hydro-electric plant to supply electricity for the Home for Homeless Boys, to replace the present steam plant. It is proposed to utilize the water of Dunlop Creek, which runs through the grounds. The cost is estimated at about $10,000.

NORFOLK, VA.—The International Cement Corporation, 342 Madison Avenue, New York, N. Y., plans for the installation of electric power equipment at its local plant in connection with enlargements to increase the output from 400,000 barrels to 1,000,000 barrels per year. Holger Struckmann is president.

WASHINGTON, D. C.—Bids will be received by the general purchasing officer, Panama Canal, until May 28, for a quantity of magnet wire, copper wire, vitrified conduit, batteries, lamp cord and lamp sockets. (Circular 1607.)

North Central States

DETROIT, MICH.—The Public Lighting Commission contemplates breaking ground this fall for a new 60,000-kw. power station. L. J. Schrenk is assistant superintendent.

ELSIE, MICH.—The Consumers' Power Company plans to erect a transmission line from Ovid to Elsie.

GRAND RAPIDS, MICH. — The Consumers' Power Company plans for the erection of an addition to its power plant on Wealthy Street, to cost about $1,800,000, with equipment.

TRAVERSE CITY, MICH.—The Boardman River Electric Light & Power Company contemplates extending its distribution line 2 miles north on the Peninsula. C. V. McMaster is manager.

CARBONDALE, OHIO.—The installation of an ornamental lighting system in the business district is under consideration. The present plans provide for forty-seven standards.

EAST LIVERPOOL, OHIO. — The East Liverpool & Beaver Valley Traction Company contemplates erecting new substations at Steubenville, Costonia, Yellow Creek, Kountz Corner, East Liverpool, Industry and near the Pennsylvania-Ohio State line, for the conversion of 22,000-volt alternating current to 625-volt direct current. The cost is estimated at about $175,000.

DECATUR, IND.—A petition for ornamental lamps on Ninth Street has been filed with the City Council. Petitions for ornamental lamps on six other streets have been granted by the Council, but all the lamps will not be installed this year.

RICHMOND, IND.—The construction of a spray pond at the municipal electric plant is under consideration. F. E. Rescher is chief clerk.

CHICAGO, ILL. — The Commonwealth Edison Company plans to erect a switching station, at Fisk Street and the Chicago River, to cost $100,000. Holabird & Roche, 104 South Michigan Avenue, are architects.

EAGLE RIVER, WIS.—Permission has been granted the municipal Electric Light and Power Department to erect a transmission line (about 25 miles long) to furnish electricity in Minocqua and Woodruff.

EAU CLAIRE, WIS.—Extensions and improvements are contemplated by the Wisconsin-Minnesota Light & Power Company to its electric, street-railway and gas service as follows: For extensions, $177,000; plant and line improvements, $1,140,870, and for new operating equipment $259,558.

GREEN BAY, WIS.—Plans have been approved by the Park Board for the installation of thirty ornamental lamps in Bay View Park. The installation of ornamental lamps in Baird's Park and St. James Park is under consideration. M. C. Simonds is park superintendent.

MADISON, WIS.—The Wisconsin Power, Light & Heat Company plans to rebuild its 13,000-volt transmission line between Beaver Dam and Oak Grove, to cost about $10,000. Plans are under way for rebuilding the electric distribution systems in Baraboo, Portage, Beaver Dam and other towns in this section of the state. The cost is estimated at about $20,000.

MERRILL, WIS.—Plans are under way by the Wisconsin Valley Electric Company for the erection of a new transmission line from Merrill to Tomahawk, a distance of 25 miles, at a cost of about $50,000.

TWO RIVERS, WIS.—Plans have been approved by the Council for extension of the ornamental lighting system on Sixteenth and Nineteenth Streets.

WISCONSIN RAPIDS, WIS.—The Wood County Electric Light & Power Company, recently organized, has contracted with the villages of Auburndale, Sherry, Blenks, Milladore, Junction City, Rudolph, Arpin, Vesper and Pittsville to erect a transmission line to supply electricity in those towns and to residents along the proposed line. Bonds to the amount $60,000 will be raised by the towns to finance the project.

LUVERNE, MINN.—Bids will be received by the City Council until June 3, for a new 350-kw. generating unit and accessories for the municipal power plant. C. W. Campbell is city recorder.

CHILLICOTHE, MO.—Bids will be received by Jewell Miller, city auditor, until May 16, for extensions and improvements in the municipal power plant, including one 500-hp. water-tube boiler, superheater, stoker, brick or concrete stack, 7 ft. in diameter and 175 ft. high. E. E. Harper, 3031 Park Avenue, Kansas City, is engineer.

MEXICO CITY, MO.—The Ford Motor Company, Detroit, plans to build a power plant at its proposed local assembling works, to cost about $500,000.

WILLMAR, MINN.—Work is now under way on the construction of a new power station for the municipal electric light and water works. N. W. Larson is superintendent.

BELLFLOWER, MO. — The Bellflower Electric Light & Power Company is planning to change its system from direct to alternating current. W. W. Metts is owner.

MOUNTAIN GROVE, MO. — The City Council, it is understood, will receive bids about May 15 for the construction of a municipal power plant and distributing system, to cost about $125,000. The Alexander Engineering Company, Woodruff Building, Springfield, is engineer.

ST. LOUIS, MO.—The Union Electric Light & Power Company plans to build a substation on Eighth Street, to cost about $160,000.

SIOUX CITY, IOWA.—The Sioux City Gas & Electric Company has started work on the construction of a new generating station. The equipment will include three 1,100-hp. boilers and two 10,000-kw. turbines. R. B. Searing is secretary.

BEATTIE, KAN.—The Beattie Electric Light Company contemplates rebuilding its transmission line and part of the distribution system. H. G. Hockman is secretary and treasurer.

GARDEN CITY, KAN.—The rebuilding of the municipal electric light lines is under consideration. Ben Bullard is superintendent.

ST MARYS, KAN.—The installation of two electrically driven water pumps in the municipal water and light plant is under consideration by the city officials. H. P. Giebler is city manager.

OBERLIN, KAN. — Preparations are being made for the construction of a transmission line for municipal service, to cost about $30,000. The Ruckel Engineering Company, Interurban Building, Hutchinson, is engineer.

Southern States

BRYSON CITY, N. C.—The Board of Aldermen is disposing of a bond issue of $100,000, the proceeds to be used for the installation of a municipal hydro-electric plant, for which plans are being prepared.

CHARLOTTE, N. C.—The property of the Canton Electric Company has been acquired by new interests. Plans are under consideration for extensions and betterments in power house and system, with the installation of additional equipment.

LAWNDALE, N. C.—The Cleveland Mill & Power Company, it is reported, will soon award contract for the construction of a hydro-electric plant on the First Broad River and will also open bids for waterwheels and electric machinery. Mees & Mees, Charlotte, are engineers.

RALEIGH, N. C. — Contract for construction of power house at the North Carolina State College of Agriculture and Engineering has been awarded to J. A. Gardner, Charlotte, to cost about $65.000. Equipment for plant will be purchased in the near future.

GREENSBORO, N. C.—The board of directors of the North Carolina College for Women has authorized the construction of a power plant at the institution to cost about $45,000.

ATLANTA, GA.—The Georgia Railway & Power Company has acquired the property of the Panola Light & Power Company, which supplies electricity in the towns of Lithonia and Conyers. The construction of distribution systems in the towns of Roswell and Flowery Beach is under consideration by the company.

BRADENTOWN, FLA. — The Southern Utilities Company is perfecting plans for an appropriation of $250,000, the fund to be used for extensions in transmission lines and local steam-operated electric power plant, including a 1,500 kw. turbo-generator and auxiliary apparatus.

HIALEAH, FLA.—The American Power & Light Company plans for extensions and improvements in the local light and power system recently acquired.

STARKE, FLA.—The municipal electric Light and Water Department is considering purchasing another motor-driven pump for the city waterworks and may extend the electric service to Lawtey during the next few months. Robert F. Clarke is superintendent of the municipal plant.

JOHNSON CITY, TENN.—Bids will be received by the Board of Commissioners until May 14 for the installation of an ornamental lighting system, consisting of about 175 standards, on certain streets as follows: (a) For constant-current regulating transformers, etc.; (b) ornamental posts complete; (c) street series lamps for tip-up burning; (d) wire and underground cable; (e) installation of the whole equipment ready for connection to the local power lines.

MARTIN, TENN.—The City Council has entered into a conditional contract with J. G. Byrd, representing the Kentucky-Tennessee Power Company, whereby the city agrees to sell the municipal electric plant and system to the company. One of the conditions of the contract is that it is not binding on either party in the event that the company fails to acquire lighting and power franchises in adjoining towns. Negotiations are under way with Dresden, Sharon, Union City, Greenfield and other nearby towns for franchises. The contract calls for the erection of a transmission line into Martin not later than Jan. 1, 1925.

MORRISTOWN, TENN.—A special election will be held May 15 to vote on the proposal to issue $300,000 in bonds for extensions and improvements in the municipal electric power plant and waterworks system.

NASHVILLE, TENN. — The Elk River Sand & Gravel Company, 307 Nichol Building, plans for the installation of electric power equipment at its proposed sand and gravel plant in the Estill Springs section. The company was incorporated recently with a capital of $150,000. W. W. Baird is president.

BIRMINGHAM, ALA.—The Birmingham Electric Company has issued bonds for $8,000,000, a portion of the fund to be used for extensions in transmission lines and substations.

JACKSON, MISS.—The American Box & Lumber Company, recently formed, plans to build a power house at its proposed local mill, to cost about $60,000. G. W. Newton, Bristol, Va.-Tenn., is architect.

SHUQUALAK, MISS.—The City Council has engaged H. A. Mentz, Magnolia, engineer, to prepare plans for an electric light plant and distributing system, to cost about $40,000.

LITTLE ROCK, ARK. — The Arkansas Central Power Company plans to erect a substation at Markham and Elm Streets, to cost about $15,000.

LITTLE ROCK, ARK. — Matthews & Company are planning for the installation of a lighting system on property at Westwood being developed for residential service. Justin Matthews is head.

PINE BLUFF, ARK. — The Arkansas Light & Power Company has issued bonds for $1,650,000, a portion of the fund to be used for extensions and improvements, including the completion of the first unit of a hydro-electric development on the Ouachita River, with capacity of 15,000 hp. Other units will be built later for an ultimate output of 120,000 hp.

NEW IBERIA, LA.—Bids will be received by the city of New Iberia at the office of the City Clerk until May 20 for furnishing and installing the following equipment in the municipal water and light plant: Two 275-kw. alternating-current generators, directly connected to Diesel oil engines, switchboard, two 1,000-gal.-per-minute centrifugal fire pumps, one 600-gal.-per-minute centrifugal pump, one 1,000-gal.-per-minute centrifugal pump (all pumps direct-motor-driven); construction of a new power house and a 200,000-gal. reinforced-concrete reservoir. J. W. Billingsley, Interstate Bank Building, New Orleans, is consulting engineer. Lawrence F. Villermin is city clerk.

FREDERICK, OKLA. — The Common Council is considering the sale of the municipal power station, with the installation of a transmission line and the use of central-station service.

DALLAS, TEX.—The Dallas Power & Light Company plans to construct a substation in the Oak Cliff section, to cost about $175,000.

FORT WORTH, TEX.—The Lone Star Tank Car Company plans to build a power house at its proposed local plant. W. A. Stuckey, Wichita Falls, Tex., is interested in the company.

SAN ANTONIO, TEX.—The Planters' & Manufacturers' Cotton Mills, Inc., recently organized by S. M. Ransopher, head of the Planters' & Merchants' Mills, Inc., New Braunfels, Tex., and associates, plans for the construction of a power plant at its proposed local textile mill, estimated to cost $1,000,000. Similar plants are projected at proposed mill at Austin and San Marcos, Tex.

Pacific and Mountain States

ABERDEEN, WASH.—The Grays Harbor Light & Power Company has applied to the County Commissioners for a franchise to erect a transmission line to serve the Wishkah Valley.

TACOMA, WASH.—The City Council is arranging an ordinance for the installation of an improved street-lighting system on Division Street.

TENINO, WASH.—Improvements are being made by the North Coast Power Company, Portland, Ore., to its system in the district between Tenino and its hydro-electric plant on the Kalama River, at a cost of about $150,000. The work will include doubling the voltage on the high-tension transmission line, about 72 miles; the erection of new substations at Tenino and Bucoda, a new high-tension switching station at the Chehalis steam power plant, new substations at Napavine, Winlock, Vader and Kalama.

BEND, ORE.—The City Council is having plans prepared for the installation of an improved lighting system in various parts of the municipality.

BERKELEY, CAL.—Improvements are contemplated by the Pacific Gas & Electric Company to its local system, to cost about $125,000. The work will include a six-way underground conduit system to tie in with the Berkeley and Oakland substations.

LANKERSHIM, CAL.—Plans have been approved for the installation of an ornamental lighting system on Lankershim Boulevard from Seventh Street to the Ventura Boulevard.

LOS ANGELES, CAL.—The Bureau of Power & Light is planning for the installation of three submarine power cables

across the entrance of the West Basin, Los Angeles Harbor. Permission has been asked.

LOS ANGELES, CAL.—The Pacific Electric Railway Company is considering the erection of a 1,500-kw. substation, near Twenty-fifth Street and Long Beach Avenue, automatic type, to cost about $100,000.

LOS ANGELES, CAL.—Ordinances are being arranged providing for the installation of ornamental lighting systems on Vermont Avenue from Washington to Fifty-eighth Street, requiring 344 pressed steel standards; on Grand Avenue from Pico to Thirty-eighth Street, 174 concrete standards, and on Kenmore Avenue, from Beverly Boulevard to Third Street, 26 concrete standards. Bids will soon be asked.

MOUNTAIN VIEW, CAL.—The Pacific Gas & Electric Company is planning to rebuild its local substation at a cost of about $138,000.

PASADENA, CAL.—The Municipal Light and Power Department is building a 3,000-kva. five-circuit substation, to be completed by Sept. 1, and 3 miles of 15,000-volt transmission line. C. W. Koiner is general manager.

SACRAMENTO, CAL.—The City Commission is considering the installation of an ornamental lighting system on Montgomery Way and on Sixth, Seventh and Tenth Avenues west of Franklin Boulevard. Albert Givan is city engineer.

SAN FRANCISCO, CAL. — The Pacific Gas & Electric Company has authorized the following work: Additional equipment, Substation I, to cost $92,000; additional equipment, substation E, $58,000; control equipment, additional transformers, feeders and accessory equipment, substation K, $51,500, and installation of tie lines between station C and station I, $13,019.

SANTA BARBARA, CAL. — Plans are being arranged for the installation of an ornamental lighting system on Carrillo Street, from De La Vina to Canal Street, nine blocks, using fluted steel standards, with cast-iron base.

WILLIAMS, CAL.—The Board of City Trustees is planning for the purchase of the properties of the Williams Water & Electric Company, to operate as municipal utilities in the future. It is purposed to make extensions in the electric system.

PROVO, UTAH.—C. E. Loose, Provo, and associates, have made application to the State Water Department, California, for permission to use waters from the East Walker River, Mono County, for hydro-electric development. A flume and pipe line 6½ miles long will be constructed.

PHOENIX, ARIZ.—The Salt River Valley Water Users' Association has preliminary plans for a hydro-electric power plant at the Horse Mesa Dam, Salt River, to cost about $3,000,000, including transmission lines. C. C. Cragin is superintendent.

BUTTE, MONT. — The Montana Power Company contemplates the erection of about 93 miles of 50,000-volt transmission lines from Billings to Coolstrip, near Hardin this year. Work is under way on the Mystic Lake hydro-electric development, near Columbus, consisting of two units of 10,000 kw. F. M. Kerr is vice-president and general manager.

FOUNTAIN, COL.—The Town Council has decided to close down the municipal generating plant and to erect a transmission line either to Colorado Springs or Stone City to obtain electricity to operate the local system. The cost is estimated at from $15,000 to $20,000.

Canada

VANCOUVER, B. C.—The British Columbia Electric Railway Company has rejected all bids submitted for the erection of a 13-mile transmission line along the west shore of Stave Lake and will build it by day labor. The cost is estimated at $100,000.

ST. BONIFACE, MAN.—The City Council has accepted the proposal of the Winnipeg (Man.) Electric Railway Company to furnish electricity for domestic and commercial lighting and power purposes for a period of twenty years.

PORT ARTHUR, ONT.—Tenders, it is reported, will soon be called by the Hydro-Electric Power Commission of Ontario, Toronto, for the construction of the fifth and sixth units (12,000 hp. each) at the Cameron Falls power development on the Nipigon River. The commission is considering raising the level of Lake Nipigon.

BENGOUGH, SASK.—The bylaw providing for the installation of an electric light plant has been approved by the ratepayers.

Electrical Patents

Announced by U. S. Patent Office

(Issued April 15, 1924)

1,490,336. BINDING POST; A. J. Lush, Cambridge, Mass. App. filed Jan. 19, 1920.

1,490,371. GROUND DETECTOR; A. C. Finney, Schenectady, N. Y. App. filed April 20, 1921.

1,490,372. METHOD OF AND APPARATUS FOR PREPARING PIGMENTS; P. Fireman, Trenton, N. J. App. filed July 10, 1922. Including the use of an electrolytic cell.

1,490,373. JUNCTION BOX; J. P. Fletcher, U. S. A. App. filed Sept. 21, 1922. Designed for military usage in the field.

1,490,382. DIRECT-READING FLUX METER; S. L. Gokhale, Schenectady, N. Y. App. filed July 30, 1920. For the determination of hysteresis loops.

1,490,384. INDUCTION METER; P. Gustavus, Berlin, Germany. App. filed April 24, 1922. With compensation device for the friction load and for preventing the operation at no load.

1,490,397. TRANSFORMER; W. S. Moody, Pittsfield, Mass. App. filed April 15, 1922. With auxiliary winding so arranged as automatically to introduce increased reactance in secondary circuit to limit current delivered to safe maximum values on short circuit.

1,490,403. ELECTRIC STOVE; J. H. Reichart, Muncie, Ind. App. filed March 17, 1922. With reversible cover.

1,490,408. PROTECTIVE MEANS FOR ELECTRIC FURNACES; T. Van Aller, Schenectady, N. Y. App. filed April 26, 1922. Provision for opening the circuit upon the occurrence of a predetermined maximum temperature in the furnace.

1,490,412. PLANER CONTROL SYSTEM; H. L. Blood, Plainfield, N. J. App. filed March 21, 1921. Using a motor-generating set for operating main and feed motor.

1,490,419. BUSHING; E. D. Eby, Pittsfield, Mass. App. filed May 5, 1919. To house the leading-in connections for incased electrical apparatus.

1,490,438. METHOD OF MAKING THERMO-COUPLE ELEMENTS; R. H. Stein, Woodhaven, N. Y. App. filed Feb. 27, 1922.

1,490,446. CIGAR LIGHTER; J. D. Wilson, Marietta, Ga. App. filed Oct. 13, 1921.

1,490,448. DRY CELL OF THE FLAT TYPE AND BATTERY FORMED THEREFROM; R. C. Benner, Bayside, and H. H. Thompdon, Flushing, N. Y. App. filed April 12, 1922.

1,490,450. PROTECTED DRY-CELL BOBBIN AND METHOD OF MAKING THE SAME; C. W. Brokate, Fremont, Ohio. App. filed Feb. 26, 1921. By precipitating a chemical compound at or near the exterior surface of the bobbin.

1,490,455. ELECTRIC BATTERY; R. H. Combs, Toronto, Ontario, Canada. App. filed April 20, 1921. Dry-cell type.

1,490,476. CHIME-STRIKING ACTION; L. D. Morris, Chicago, Ill. App. filed April 29, 1921.

1,490,481. WRAPPING MACHINE; G. W. Prouty, Boston, and J. Derry, Medford, Mass. App. filed May 9, 1923.

1,490,504. ELECTRODE; D. M. Boothman, Parnassus, Pa. App. filed May 20, 1922. For use in electrolytic cells.

1,490,530. ELECTRIC FURNACE; P. Ewerbeck, Garmisch, Germany. App. filed June 4, 1921. For calcining limestone.

1,490,552. RECENTERING DEVICE FOR ELEVATOR CONTROL; C. J. Anderson, Chicago, Ill. App. filed March 7, 1923. For elevators controlled by a cable.

1,490,567. AUTOMATIC TRAFFIC SIGNAL; H. A. Kleinsteuber, T. E. Hayes, Milwaukee, Wis. App. filed Sept. 12, 1921.

1,490,573. FIRE-ALARM SIGNALING SYSTEM; W. J. Luse, New York, N. Y. App. filed June 8, 1920. Using a sound-producing device and a telephone.

1,490,621. ELECTRIC HEATER; B. B. Miller, Detroit, Mich. App. filed May 31, 1922. To heat water and maintain it at a desired temperature.

1,490,647. PROCESS OF MAKING ENDLESS METAL FORMS; E. Thomson, Swampscott, Mass. App. filed March 16, 1921. As chain links using electric current.

1,490,673. SYSTEM OF MOTOR CONTROL; E. S. Matthews, New York, N. Y. App. filed May 2, 1918. For elevator operation, heavy gun pointing, etc.

1,490,679. REPEATER CIRCUITS; E. J. Pratt, New York, N. Y. App. filed Sept. 28, 1922. Whereby an electric discharge electrode and a transmitter may be simultaneously supplied with energizing current from a common source of voltage.

1,490,690. FLASHLIGHT BULB SUPPORT; E. R. Barany, Brooklyn, N. Y. App. filed Aug. 14, 1922.

1,490,695. CONNECTER; T. W. Davis, Elizabeth, N. J. App. filed March 22, 1921. For cable.

1,490,702. ELECTRICAL LOUD-SPEAKING RECEIVER; H. Koester, Waterbury, Conn. App. filed June 19, 1922.

1,490,708. DYNAMO-ELECTRIC MACHINE; M. L. Norris, Fort Wayne, Ind. App. filed June 21, 1921. Of the single-phase commutator type which start as repulsion machines and run as induction machines.

1,490,720. SYSTEM OF MOTOR CONTROL; E. F. W. Alexanderson, Schenectady, N. Y. App. filed Jan. 9, 1922. For stopping, starting, etc., using an electron discharge device to regulate the supply of energy to the controlling means.

1,490,730. ATTACHMENT PLUG; T. A. Both, Stratford, Conn. App. filed July 26, 1921.

1,490,732. ELECTRIC FURNACE; T. F. Callaghan, Cleveland, Ohio. App. filed Oct. 23, 1918. Resistance type.

1,490,733. MOTOR CONTROL; F. B. Crosby, Worcester, Mass. App. filed Sept. 5, 1919. Whereby a predetermined relationship between the speeds of two separately driven, mechanically independent elements may be effected and automatically maintained.

1,490,740. RELAY SWITCH FOR CLOCK-CONTROLLED ELECTRIC SIGNAL DEVICES; J. F. Hielscher, Seattle, Wash. App. filed Feb. 15, 1921.

1,490,742. SOUND-DETECTING DEVICE; A. W. Hull, Schenectady, N. Y. App. filed June 8, 1919. For detecting sounds or similar vibrations transmitted through a fluid medium.

1,490,750. REPRODUCING AND TRANSMITTING DEVICE; A. P. Pinkler, Ridgefield, N. J. App. filed Feb. 18, 1921. For a phonograph.

1,490,767. ELECTRICAL HEATING APPLIANCE; E. De F. Curtis, Wayne, Pa. App. filed Jan. 23, 1922. Hot plate.

1,490,776. MOTOR CONTROL; B. W. Jones, Schenectady, N. Y. App. filed March 29, 1922. For use with motor driving a tube-drawing machine, etc.

1,490,792. MAGNETIC SEPARATOR; L. B. Woodworth and S. T. Tregaskis, Johannesburg, Transvaal, South Africa. App. filed May 11, 1921. For ore and other materials.

1,490,842. VARIABLE INDUCTANCE FOR RADIO APPARATUS; S. Molina, New York, N. Y. App. filed Dec. 8, 1922.

1,490,843. ELECTRICAL FIXTURE; H. J. Morey, Syracuse, N. Y. App. filed March 22, 1920. With means for connecting with the line wires in an outlet box.

1,490,853. LOUD-SPEAKING TELEPHONE RECEIVER; W. Van B. Roberts, Princeton, N. J. App. filed May 16, 1922.

1,490,901. FLOW INDICATOR; A. B. Hendricks, Jr., Pittsfield, Mass. App. filed Sept. 2, 1919. To indicate that the flow of a fluid through a pipe is maintained.

(Issued April 22, 1924)

1,490,948. HAIR-WAVING HEATER; E. Unger, New York, N. Y. App. filed Aug. 26, 1922.

1,490,958. FREQUENCY-CONTROL SYSTEM; R. Brown, Freehold, N. J. App. filed Nov. 23, 1921. For radio signaling.

1,490,960. COMBINATION ELECTRIC FAN AND HEATER; W. Carduner, New York, N. Y. App. filed May 18, 1920.

1,490,990. RESISTANCE THERMOMETER; G. F. Taylor, Washington, D. C. App. filed Dec. 13, 1923.

1,490,993. APPARATUS AND CIRCUITS FOR PREVENTING SIDE TONE; J. F. Toomey, New York, N. Y. App. filed May 12, 1919. In telephone circuits.

1,490,999. DETECTOR OF PROJECTILE PATHS; P. A. Blair, Washington, D. C. App. filed Dec. 19, 1919. For application to torpedo-testing range, etc.

1,491,024. ELECTRIC FIRE LIGHTER; H. Berryman, Centerville, Mont. App. filed April 13, 1923.

1,491,033. AUTOMOBILE SIGNAL LAMP; R. A. Cummings, Jr., Pittsburgh, Pa. App. filed March 10, 1923. Combined tail light and direction indicator.

1,491,040. PROCESS OF MANUFACTURING SELENIUM CELLS FOR PHOTO-ELECTRIC WORK AND CRYSTAL RADIO DETECTORS; Russel Hart, Alhambra, Cal. App. filed March 24, 1921.

1,491,056. CLAMP FOR BATTERY CONNECTIONS; F. Morrison and F. W. Mays, Huntington, W. Va. App. filed May 5, 1923. For attaching to terminal of storage battery.

1,491,073. METHOD OF MANUFACTURING VALVES; J. L. Wells, Detroit, Mich. App. filed March 25, 1920. Electrically welding cast-iron head to stem of poppet-type valve.

1,491,108. ELECTRIC GENERATOR; G. H. Sethman, Denver, Col. App. filed Feb. 2, 1918. Polyphase generator with induced windings.